大正七年七月十日第三種郵便物認可

THE FAR EASTERN REVIEW

ENGINEERING FINANCE COMMERCE

LE UNIVE
N 2 6 19
IBRARY

上海仁記路第五號

遠東時報

SAITO

HIS WORK IN KOREA

THE PORT OF MANILA

HYDRO-ELECTRIC DEVELOPMENT IN N.E.I.

THE DAMAR INDUSTRY

GOLD MINES IN THE PHILIPPINES

CALOOCAN SHOPS OF THE MANILA RAILWAY

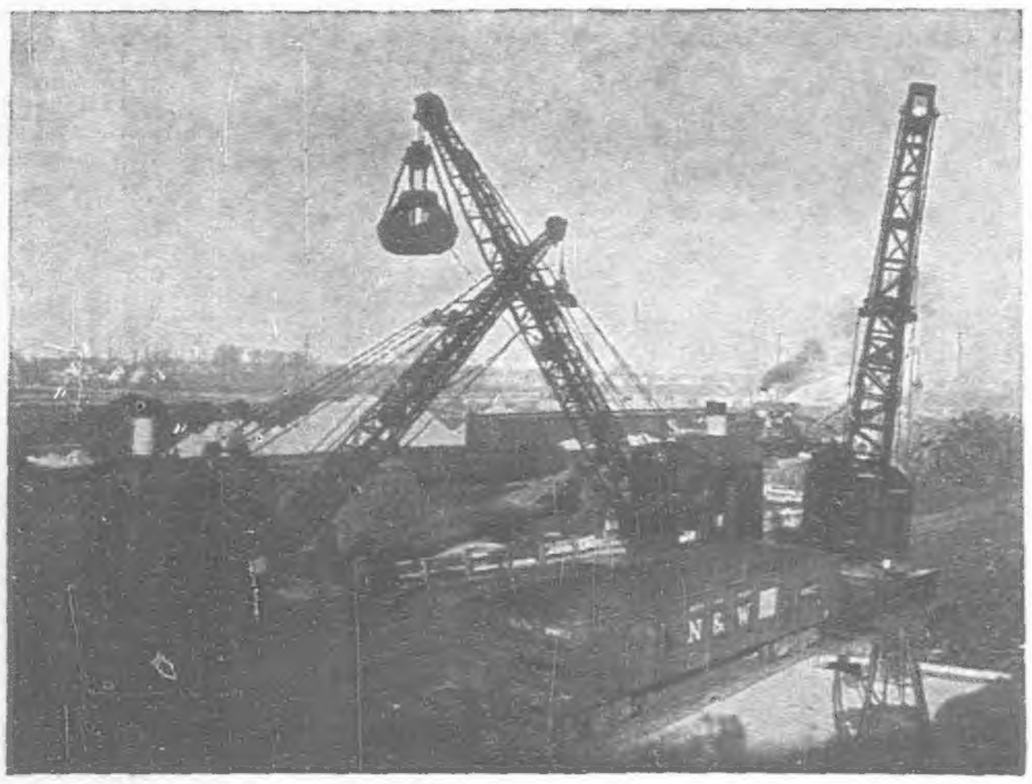
TIN MINING IN MALAYA

ELECTRIFICATION OF JAPANESE RAILWAYS

Vol. XX December, 1924 No. 12

SHANGHAI, PEKING, TOKYO AND MANILA

2



LIFE-LONG MATERIAL HANDLING ECONOMY

BROWNING Locomotive Cranes reduce the cost of handling heavy materials to the lowest figure possible—and effect these production savings through a lifetime of hard service.

The utmost economy is accomplished by Brownings in every phase of material handling. Whether operating with bucket, magnet, hook-block, wood grapple, drag line, steam shovel or pile driver attachment and as a switch engine, Browning economies are positive and long-lived.

Write for complete illustrated catalogue

THE BROWNING COMPANY

CLEVELAND, OHIO, U.S.A.

Cable Address: "BROWNING"

BROWNING

LOCOMOTIVE CRANES AND BUCKETS

REA'S FAR EASTERN MANUAL

1924

The 1924 edition of this stupendous compilation of concrete facts, covering the main Engineering and Industrial establishments of Eastern Asia, should be on the desk of every executive of the Engineering and Financial professions doing business in the Orient. Order your copy now.

Price Mexican **$25.00** or its equivalent

GEORGE BRONSON REA, M.E.

Editor and Publisher

16 Jinkee Road *Shanghai, China*

The Far Eastern Review

ENGINEERING FINANCE COMMERCE

VOL. XX SHANGHAI, DECEMBER, 1924 No. 12

SAITO

The Man Who Stood by Dewey at Manila

His Work in Korea

AN APPRECIATION

By Geo. Bronson Rea

WHEN Dewey shattered the Spanish fleet in Manila Bay in 1898 and issued his famous order subjecting all incoming vessels, including warships, to visit and special port regulations, von Diederich, the German admiral, resented this assumption of power and decided to disobey it. There was also a solitary Japanese cruiser, the "*Akitsushima*," at anchor in the bay. Von Diederich's aide (von Hintze) called on its captain and urged him to ignore Dewey's regulation on the grounds that it constituted a violation of international law. The Japanese captain, however, refused to intervene replying that Dewey was right, that he would do the same if placed in the same position and he would accept the visit of the American naval officer as a welcome call of courtesy. That Japanese captain has since ascended the rungs of the naval ladder to the top, retiring from the service two years later with the rank of admiral and the title of baron. Entering politics as a liberal he forged to the front as one of Japan's ablest statesmen and administrators. Admiral Baron Makoto Saito is now governor-general of Korea, the most difficult post in Japan's civil service. He is still the same stanch friend and admirer of America and lover of fair-play as he was twenty-five years ago when he stood by his British colleague in an incident deliberately created to deprive America of the fruits of Dewey's victory. Had Saito accepted the German invitation, the history of the Far East since that date would have been written in another way. It is well to remember this almost forgotten incident at a time when American sympathies are being worked upon by propaganda calculated to deprive Japan of the fruits of her victory in the greater war which followed in 1904.

This incident may be accepted as convincing proof of Japan's declaration that she has no aggressive designs on the Philippines, for had she held such ambitions, then was the time to line up with Germany and dispute Dewey's right to play the rôle of conqueror. When, some years later, Roosevelt accepted Japan's assurances that she had no designs upon the Philippines and on the strength of this assurance entered into what for all practical purposes was a secret alliance with Japan for preserving the peace of the Far East, he acknowledged Japan's right to protect her national existence through the military occupation of Korea. The secret understanding between Roosevelt and Katsura might well be interpreted as a mutual recognition of the rights of their respective countries over these two dependencies, an unconstitutional method on the part of Roosevelt of arriving at a solution of Pacific problems that seventeen years later was endorsed at Washington through the four-power treaty. At that time it would have been impossible to put through a formal alliance, so Roosevelt in his own good way assured our position in the Philippines without reference to congress.

Admiral Baron Makoto Saito, Governor-General of Korea
The Man Who Stood by Dewey at Manila

Roosevelt stood firmly by Japan while he remained in office and to the time of his death was outspoken in condemnation of the anti-Japanese propaganda which flooded our newspapers and nearly led to war between the two countries. When asked to intervene between Japan and Korea, he said that America could not do for the Koreans what they were unable or unwilling to do for themselves. Korea passed under Japanese rule and was annexed as part of the empire. Notwithstanding our solemn assurances to concede independence to the Philippines as soon as they are fitted for self-government, the American flag still floats where Dewey planted it with a fifty-fifty chance that it will never be hauled down. The Philippines may yet be permanently annexed to the United States. Although such annexation would perpetuate our exclusion policy in an Asiatic territory, the Japanese have at no time challenged America's right to decide the future of the islands in her own way. America's position in the Philippines will never be menaced by Japan, a policy proclaimed to the world in 1898 for the first time by Captain Makoto Saito of the Imperial Japanese Navy and reiterated by Count Katsura, seven years later.

Although Roosevelt's recognition of Japan's right to protect her vital interests by annexing Korea, may have come prior to the understanding with Katsura and had no direct bearing on Japan's recognition of America's position in the Philippines, it will be difficult to dissociate one from the other. America's recognition of Japan's rights in Korea received its *quid pro quo* in Japan's recognition of America's position in the Philippines. The Roosevelt-Katsura agreement admits of no other interpretation.

For Japan, possession of Korea was a vital strategic necessity, the working out of the ages old law that the rights of a weak people disappear when they place in jeopardy the life of a stronger and better organized state. Japan entered Korea and made many mistakes, the natural outcome to a situation which compelled her to be ever on the alert against the moves of Russia in preparing for her war of revenge. Korea was then and will always remain, the strategic key to Japan's independence and with a vindictive enemy working against time to get into a position to renew the conflict terminated by the peace of Portsmouth, the administration of Korean affairs could not with safety be left to civilians. Most of Japan's troubles in Korea are traceable directly to the military *regimé* which subordinated other important measures to the strategical needs of the moment. This critical period ended with the great war and for the first time Japan could breathe easier and devote special attention to the application of much needed reforms in her new dependency. From the many excellent administrators that might have been selected for the post of governor-general, the choice of the cabinet and elder statesmen fell on Admiral Baron Saito, whose prominence in Japanese political life is better understood when it is recalled that had he wished, he might have been premier last year after the death of his colleague Viscount Admiral Kato. Much could be written about the splendid reforms placed in operation since he accepted the Korean post in September 1919 and devoted himself to the accomplishment of a task which will prove the crowning achievement of his life, and a monument to Japanese liberalism and tolerance.

Admiral Baron Saito is still an active force in the political life of his country with the possibility that he may be called upon at some future crisis to head the cabinet. The peace of the Far East, as far as Japanese aggression on the Philippines is concerned, is in no danger of being broken as long as statesmen of the calibre of Admiral Baron Saito exert an influence on the affairs of Nippon. The man who shaped the policy of his country in 1898 has the supreme satisfaction of knowing that his action was endorsed when Katsura and Roosevelt exchanged confidences in 1905, and has lived to see this informal agreement incorporated into the four-power alliance of 1922, in which America's position in the Philippines is assured against attack while Korea, the vulverable point in Japan's armor, is exposed to the menace of invasion. Swayed by a wave of anti-Japanese sentiment and driven forward by a group of hysterical Chinese propagandists, America demanded the cancellation of the Anglo-Japanese alliance, the only effective guarantee that Japan would never again be attacked through Korea. In order to demonstrate Japan's friendship for America, Baron Kato (Saito's naval colleague) cheerfully accepted the heavy responsibility of defending unaided the empire against an attack "from the direction of Urga." Peace in the Pacific was purchased at the expense of peace in Asia. While America enjoys the blessings and security that the new international agreement brings to the people of the Philippines and the Pacific coast, Japan, prostrated by a disaster that wrought greater havoc than any war, once more faces an uncertain future in Korea and Manchuria. All that she won during twenty years of diplomacy and unceasing vigilance in Asia has been taken from her. American naval strategists declare that the United States surrendered command of the Western Pacific to Japan at Washington, placing her in a position to attack Guam and the Philippines whenever in her opinion such action seems necessary, a one-sided argument advanced by big-navy advocates in order to increase the strength of the Pacific fleet. The fact that Japan surrendered her one guarantee against aggression from the other direction in exchanging an alliance with teeth in it for one that had passed through the hands of skilled American dentists is altogether lost sight of in the mad craze to keep her before the country as the hypothetical enemy. As a consequence, Japan now stands face to face with the grim realities of a situation that may at any time get beyond the control of diplomacy. Russia is again entrenched in Manchuria, exerting every pressure upon Japan to compel acquiescence to her demand for recognition. Mongolia is lost to China. Soviet influence at Peking for the moment is supreme. Through its control over the Chinese Eastern Railway, the Soviet has started a commercial war to undermine Japan's economic position in South Manchuria and Mongolia. The peace of the Far East hinges largely on Japan's right to develop these regions without interference. The clock has been turned back and we are now exactly where we were in 1914 at the outbreak of the great war. At Seoul, sits the man whose decision in 1898 marked the commencement of a policy on the part of his government which assured to America the peaceful enjoyment of the fruits of Dewey's victory; is it too much to ask that American sympathy and support be now extended to Baron Saito in the tremendous efforts he is making to assure to Japan the peaceful enjoyment of the fruits of her victory in 1905?

The New Era in Korea

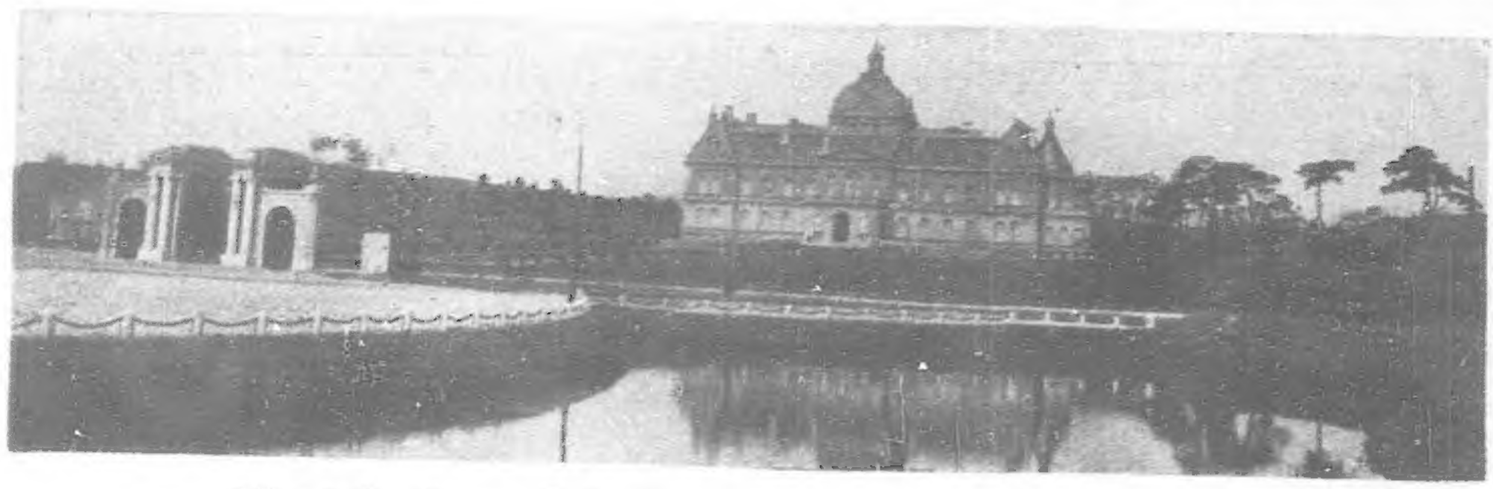
Baron Saito's administration marks a new era in the history of Korea through the abolition of the program of assimilation which characterized the rule of his predecessors and the inauguration of a new program based on the absolute equality of Koreans and Japanese as subjects of the empire. Administrative reforms were immediately adopted and placed in operation for implanting autonomy in local and provincial affairs and the way cleared for Koreans to have free access to the governor-general and lay their complaints directly before him. The ban on the publication of vernacular newspapers was raised, the unpopular wearing of uniforms and short swords was abolished and sweeping reforms made in the police system so that there are now 8,088 Koreans to 7,445 Japanese in the personnel of the force with about half the posts of superintendents, inspectors and assistant inspectors filled by natives. This radical departure from the old Japanese gendarme system makes practically impossible any repetition of the police outrages which followed the rising of 1919. Judicial reforms based on a new civil code drawn up with respect for Korean customs and traditions are now working smoothly. Whipping has been abolished and every effort is being made to secure the co-operation of Koreans in maintaining law and order by giving them equal supervision over the machinery of justice.

Provincial assemblies have been created, the members showing an earnest and conciliatory disposition to learn the rudiments of self-government, carrying on their discussions in an orderly and gentlemanly manner. Business has so far proceeded smoothly and the experiment seems to have been a success. What will happen in the future as the Koreans are given a larger share in their own government, remains to be seen. A fundamental educational system based on the methods employed in Japan has been drawn up and applied so that it can be fairly said that Baron Saito's cultural program stands on a par with that of any European colonizing power. In fact, one noted British writer has said that he would prefer to be a Korean under Japanese rule than a Hindu under Great Britain or a Zulu or Kaffir under the union government of South Africa. Korea now has six colleges, 25 technical schools and 55 elementary technical schools besides 870 primary and 21 high schools with an attendance of over 300,000. No less than 7,000,000 text-books are printed annually for the use of these schools.

The Economic Side

After laying a firm economic foundation, Japan is elevating the cultural status of the Korean in preparation for a larger share in his own government. But, as in the Philippines and China, so in Korea we find that modern education carried past a certain point makes for political discontent, creating an overwhelming desire for an official career as soon as school days are over. The Korean high school or college graduate sees little dignity in labor. He is adverse to agriculture or industry and although willing to go into banking or commerce, prefers the civil service where he invariably falls down in the examinations because of insufficient preparation and study. Disappointed in failing to obtain immediate employment, he complains loudly of discrimination.

The Korean holds a natural grievance against Japan for the loss of his nationality and seizes on anything that will keep alive national resentment. The older generation, recognizing the great difference between the present and the past regime, are mostly contented with the change, but the youngsters fresh from college who have no background or knowledge of what native rule really



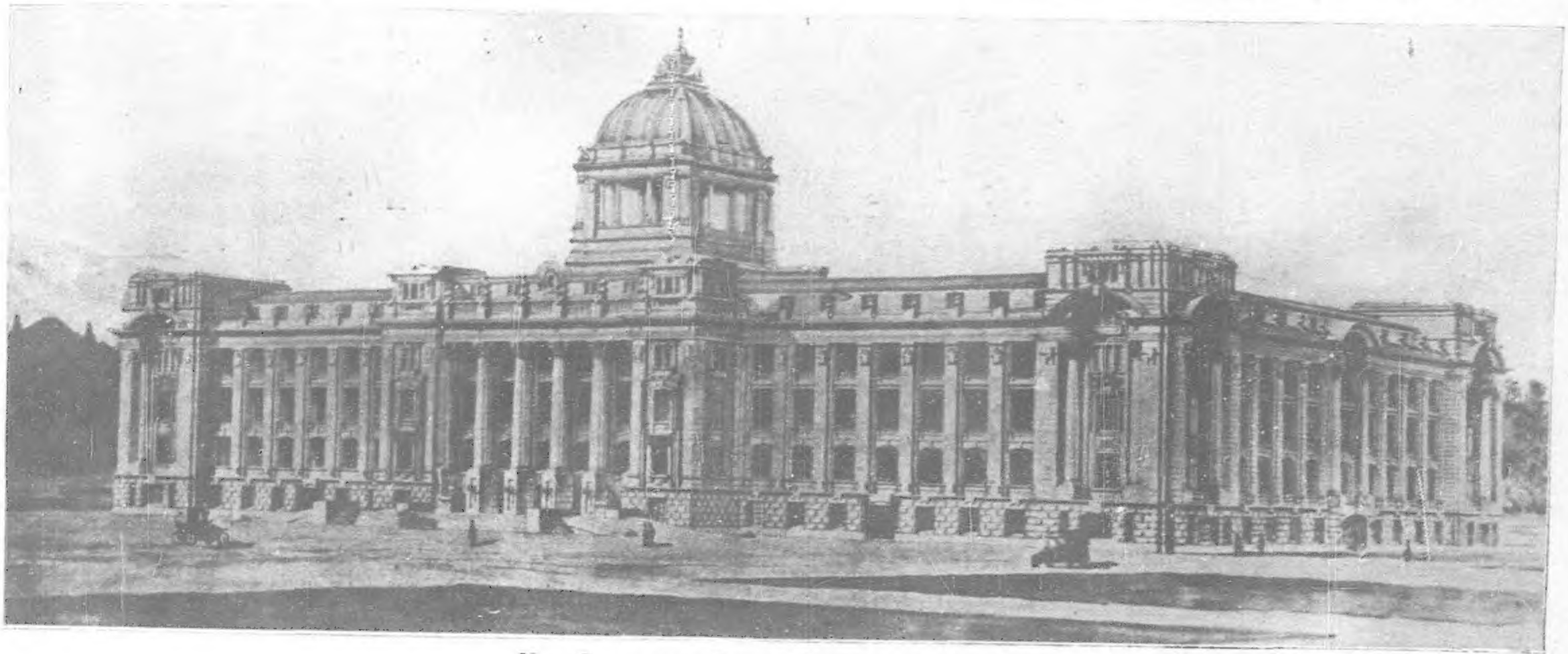
Official Residence of the Governor-General of Korea at Ryuzan

was in the past, are keen to have a larger share in the management of their own affairs. The broader-minded Japanese realize that the only way to conciliate this element is to place the Korean on a plane of absolute equality and as they demonstrate ability and loyality to give them positions of trust not only in the government of Korea but in other parts of the empire. These Japanese point to the fact that many of their best officials have come from the Loochoo Islands and believe the Korean student graduates would find a better opening in Japan proper and in Formosa than they will, in their own country, for some time to come.

It is the same old story of colonial government told in another way. The modern educated Korean believes he has arrived overnight to the point where he is able to govern himself and as time goes on, the Japanese will be compelled to concede this privilege more and more in order to consolidate Korea as an integral part of the empire. Realizing this, Baron Saito is doing everything possible to meet these legitimate aspirations, but no matter how far he may go towards this end, experience tells us that he will fall short of Korean expectations.

Thinking Japanese realize that many sacrifices must be made in order to transform Korea into a patriotic Japanese province, taking its place as the main defense of the empire against aggression from that direction. The friendship and allegiance of the Korean people is essential to the success of this plan and to gain their good-will and confidence is the fundamental plank in the new Japanese program for the administration of their country. The Japanese, wisely believe that the first step towards the attainment of this end is to better the material condition of the Korean by providing him with remunerative work and a market for his products. With this object always in view and under just laws and the resultant security for life and property, comparative prosperity has come to the Korean people. Good harvests, transportation facilities, river conservation, afforestration, industrialization, better living conditions, sanitary improvements and other benefits arising from good government have contributed in a large measure to the increase of the population from 13,313,017 in 1910 to 17,288,987 in 1920, or nearly thirty per cent. in ten years.

Here we have an example of how a beneficent rule operates on the Asiatic birth rate. The Koreans are doubling their numbers in thirty years, twice as rapidly as the Japanese

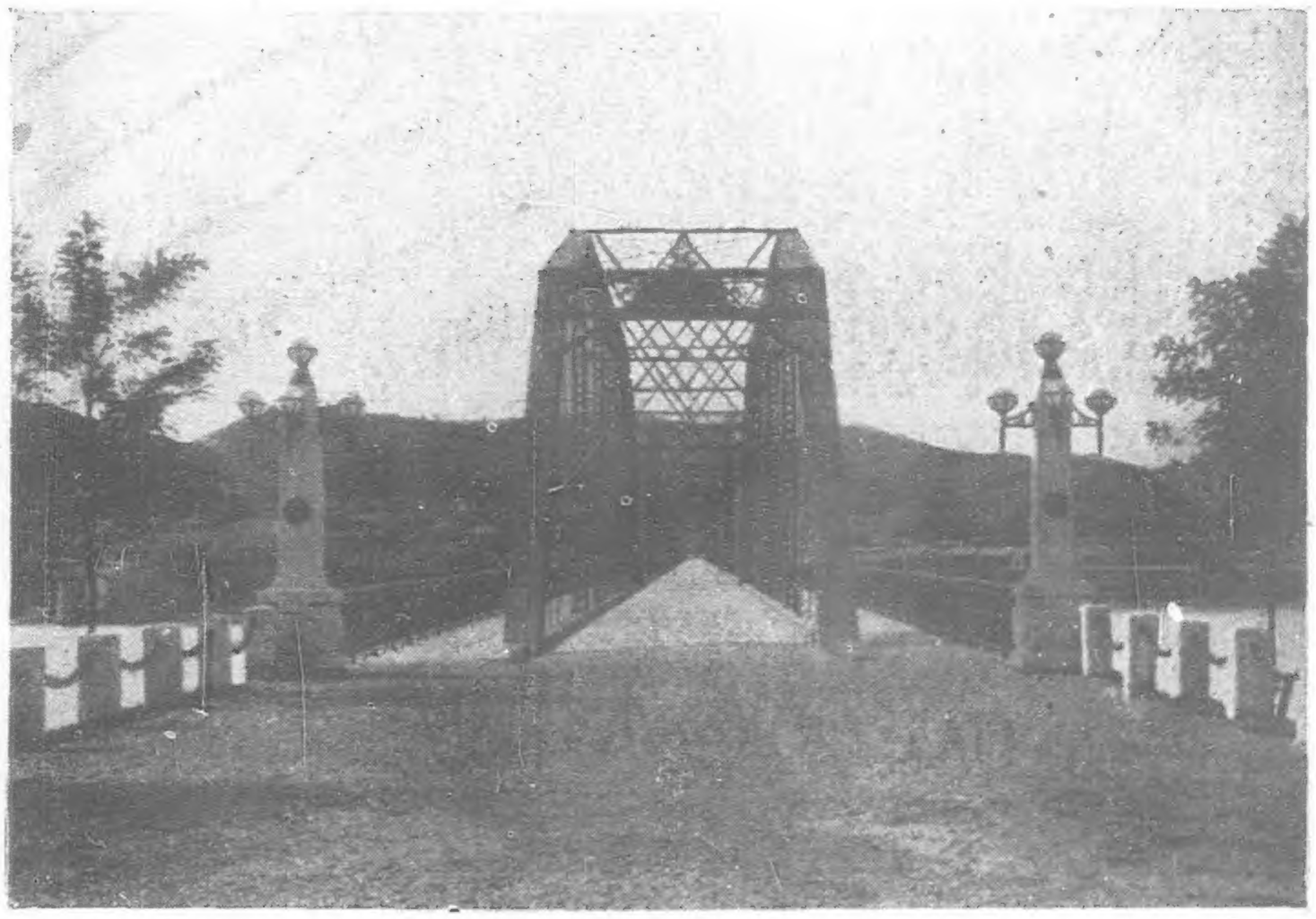


New Government-General Building at Seoul

Offices of the Government-General at Seoul

The New Government Museum at Seoul

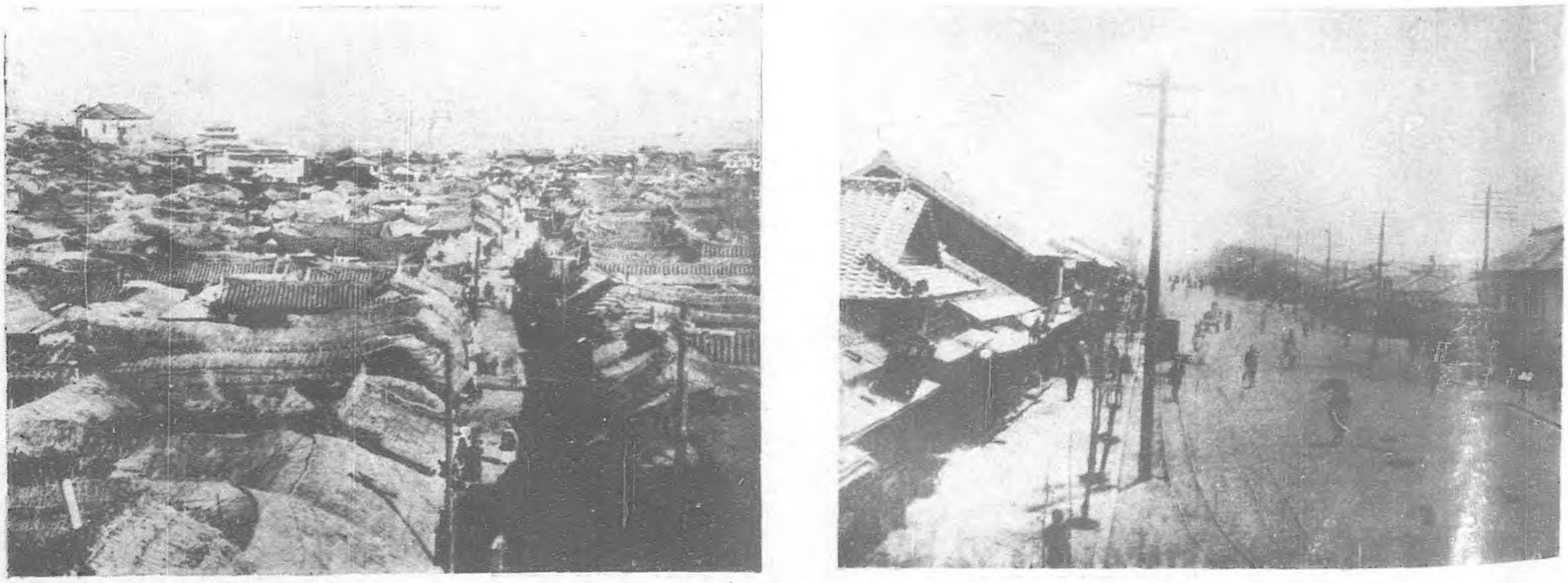
and nearly six times as rapidly as the average white nation of Europe. Under these conditions, Korea offers no real solution to Japan's major population problem unless the Koreans are ousted from their lands to make room for the Japanese overflow. Like his Japanese and Chinese cousins, the Korean is rooted to the soil, opposed to emigrating except as a last resource. When he does make up his mind to seek a home elsewhere, he steps over the border into Manchuria and Siberia and looks to the Japanese government for protection. As a Korean, he is more or less welcomed by the Chinese and Russians, but as a Japanese subject carrying with him the principle of extra-territoriality, he becomes an object of persecution which materially adds to Japan's burdens in these territories. If the Korean continues to increase at the present rate he must in time slop over the border into Manchuria and the Russian maritime provinces. When this problem is added to Japan's ever present necessity of increasing her sources of food supply from within the empire in order to feed her own mounting millions, the task which confronts the Japanese authorities in Korea is not an enviable or an easy one. As time goes on it is inevitable that the Koreans will raise the cry that every Japanese who makes his home in their country is depriving a Korean of his patrimony, and every Korean forced over the border to seek his existence will harbor a grudge against Japan. It is easy to see that the solution of Japan's problems in so far as they pertain to Korea, will call for the most delicate handling, another reason why his government selected Baron Saito as the man best fitted to tackle a situation that had been man-handled by the militarists.



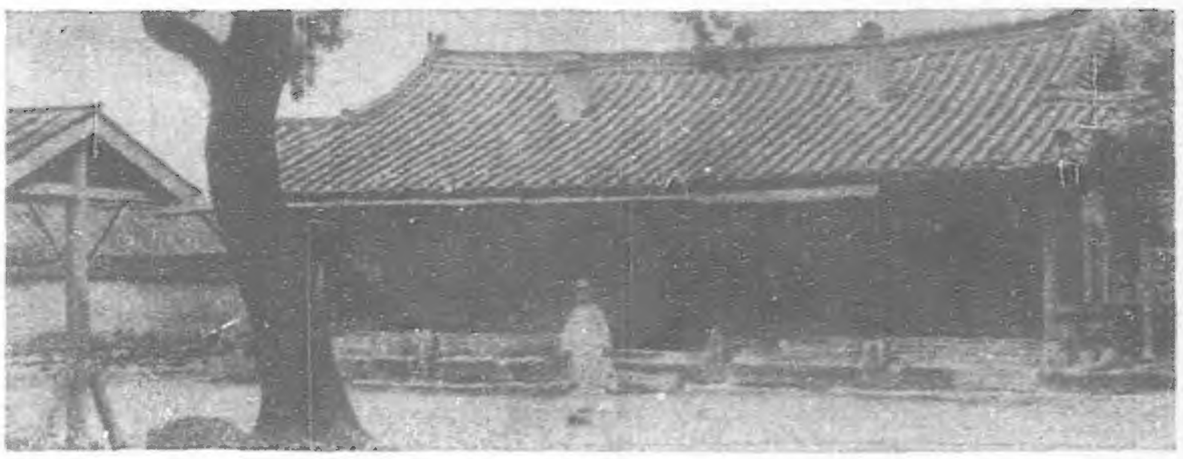
New Steel Highway Bridge over the Kan River

Typical New Road Construction in North Chusei Province

Korea has always had an unfavorable balance of trade, its government being maintained in part by annual subsidies from Tokyo, while loans had to be raised for carrying out essential public improvements. Income from all sources from 1910 to 1921 exceeded Y. 1,090,000,000 but the sums paid out during this same period for importations reached Y. 1,440,000,000 an adverse balance of Y. 350,000,000. Faced with this condition, the administration of Baron Saito has concentrated on measures that will encourage the investment of new capital for the development of industries and the building of public works



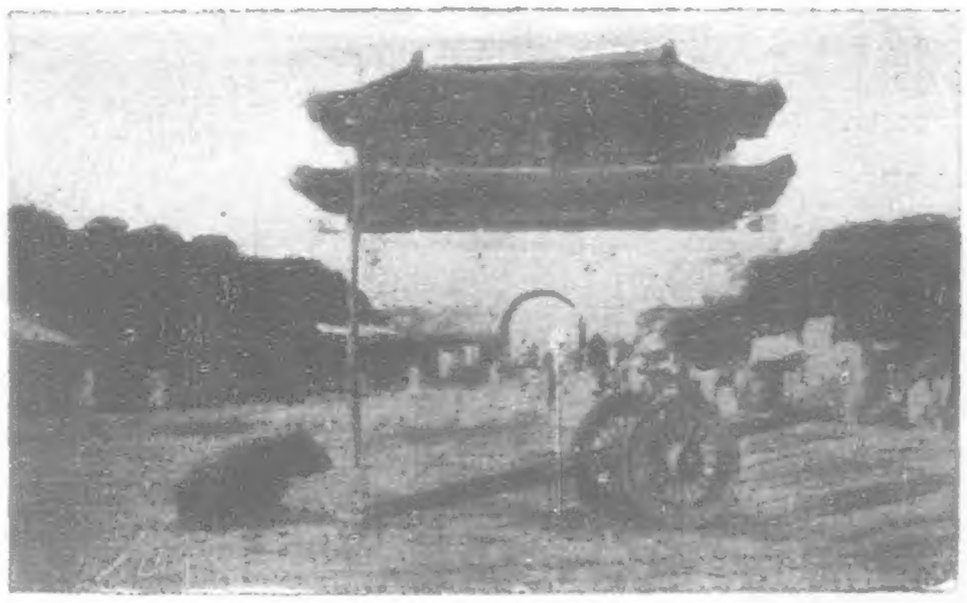
The Old and the New: A Typical Old Korean Street in Heijo and the New Wide Avenue that now provides Transportation Facilities in the Same City

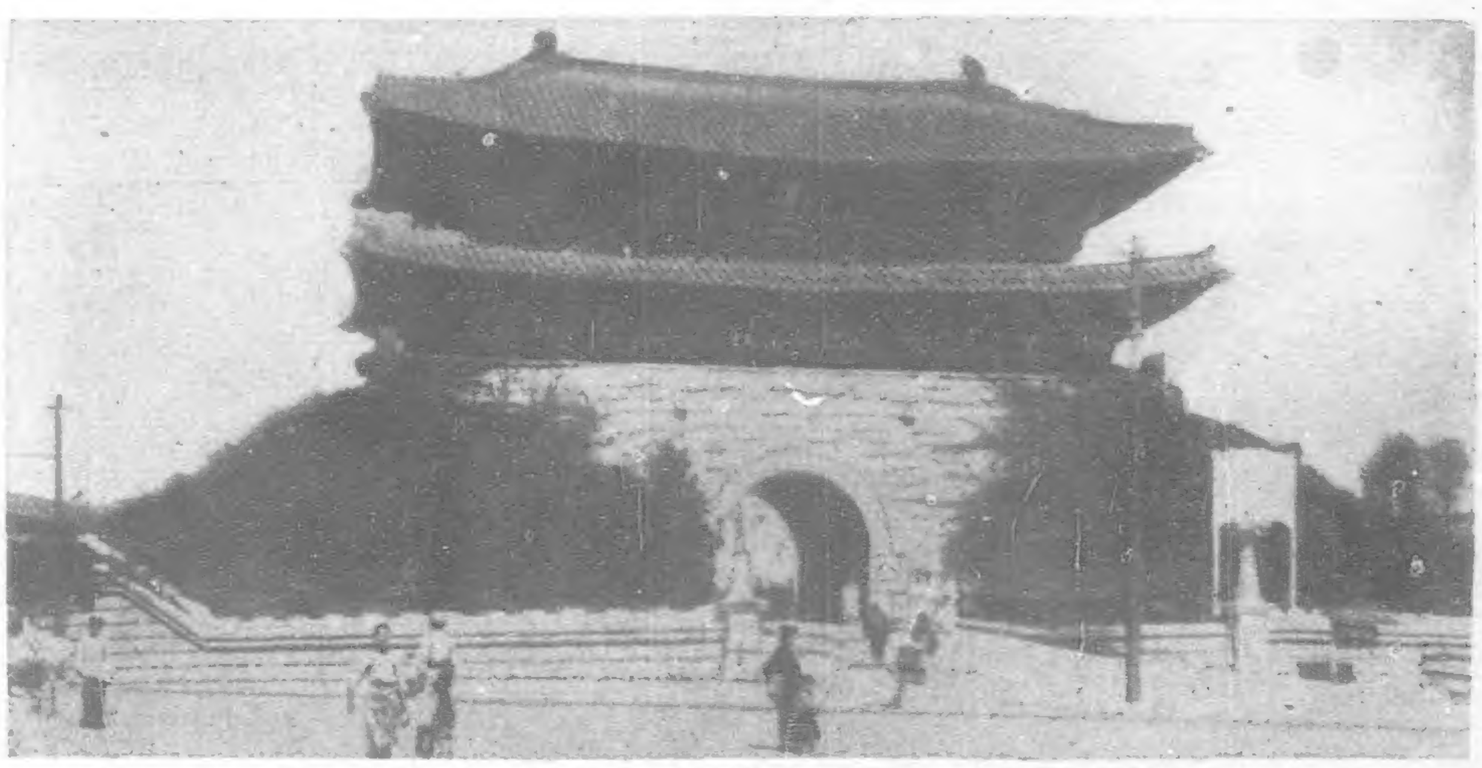


The Old and the New—A Korean Post Office Before Annexation (top); The Present Post Office at Keijo. Sides, Old Korean Postman and Present Types

that will increase the wealth of the country. The result of this policy has wrought great changes in the industrial life of the peninsula and by the end of 1920 there were 2,088 industrial establishments capitalized at Y. 160,000,000 employing 55,200 hands, but as a result of the general readjustment which followed the boom period there were in existence at the end of last year 1,071 companies, not including banks, having a paid-up capital of Y. 154,000,000. The process of elimination and merging the smaller companies into the stronger combinations is still going on and there will probably be a further decrease next year in the number of industrial companies with a corresponding increase in capitalization, output and efficiency. This policy is already having a marked effect on the prosperity of the country, for with thriving industries and an unusually good market for staples, the exports from Korea for the first half of this year reached Y. 167,000,000 an increase of 25 per cent. over the same period of last year. For the first time in seven years the balance of trade was favorable, exports exceeding imports by Y. 6,200,000. In other words, Korea has turned the corner. Confidence in the future is being rapidly restored with a resultant stimulus to further efforts. A revival is noticeable in the mining industry which even as yet on a small scale, promises greater things. The future industrial centre of Korea will undoubtedly be located at the old town of Pingyang, now known as Heijo. Situated in the midst of a coal and iron district and with the possibilities of hydro-electric development in the Pingyang River, the dreamy old Korean city is fast being transformed into a modern industrial centre. A large beet sugar factory, the Mitsubishi Iron and Steel Works, coal mines, an extensive arsenal, many breweries and an electric power plant form the nucleus for this development. In a subsequent article we will deal more at length with some of the most important of these varied industries scattered throughout the country, of which over fifty are capitalized in excess of Y. 500,000.

Hand in hand with the encouragement of industries has gone afforestration, irrigation and the improvement of harbors and roads. Vast tracts have been reclaimed by irrigation and planted to rice and Korea is now exporting to Japan over 3,000,000 *koku* of this commodity annually, a very important addition to its food supply. Some of the larger irrigation works will be described in subsequent articles.





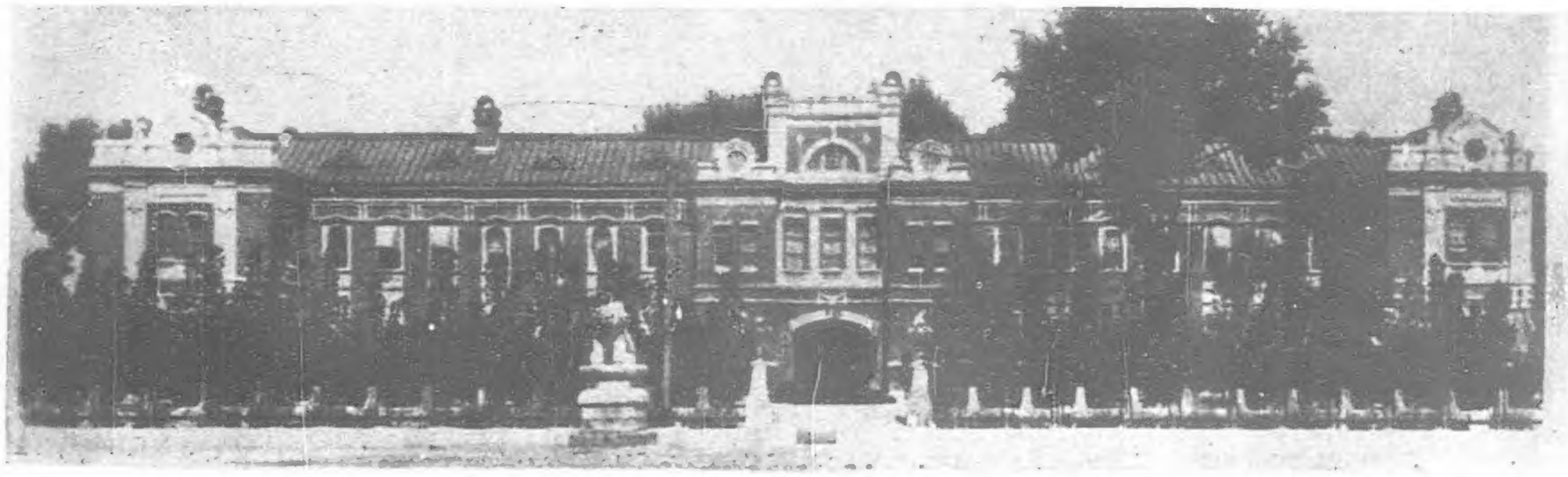
Contrasts: The Great South Gate, the Main Entrance to Seoul as it appeared Twenty Years Ago and To-day

The general program for industrial development and the extension of public works, roads, harbor improvements, etc., has been considerably curtailed owing to the drastic financial retrenchment in all branches of the Japanese government and this year the expenses are being cut down some Y. 40,000,000 in order to meet the changed conditions. The Imperial Government, however, will extend a subsidy of Y. 15,000,000 for the Korean administration and the latter will be empowered to raise loans to the extent of Y. 10,000,000.

The Roads of Korea

An Australian writer, who recently visited Korea, says that if one was dropped from an aeroplane into the middle of an old Korean town surrounded by the thatched roofs of houses that resemble giant mushrooms, he would find no street corners and be quickly lost trying to find a way out of the labyrinth. This condition, however well it may describe some of the smaller

towns is certainly not applicable to the larger centres where the construction of good roads and streets have gone hand in hand with the other improvements which characterize Japan's administration of the country. Under its native rulers, Korea hardly knew what a road looked like, all transportation being by coolie or horse along narrow, deep-rutted and meandering tracks which began nowhere and ended nowhere. It was not until 1906 that modern road construction was commenced, when the Japanese laid out the first four roads of a total length of 65 *li*. By 1910, 205 *li* were completed at a cost of Y. 3,900,000 and immediately after the annexation a definite construction program was drawn up in which all roads were classified under four heads.



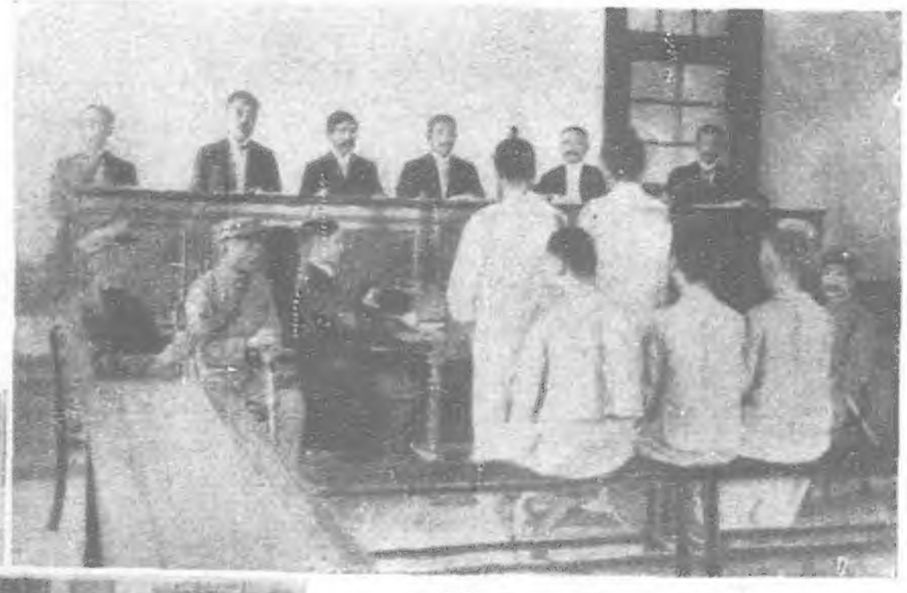
Old Style Korean Provincial Government Yamen and Type of New Office Buildings

Appeal Court at Taikyu

Appeal Court at Heijo

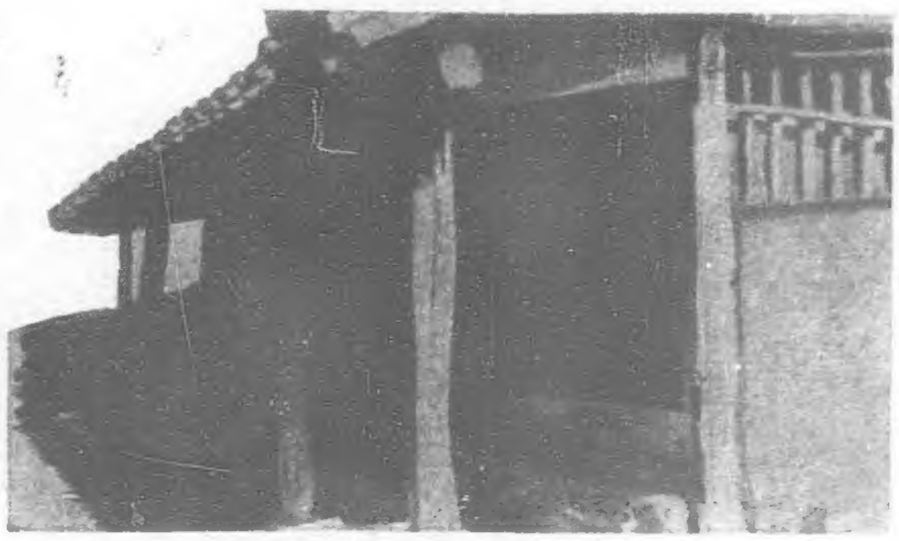
District Court at Tyong-jyu

First-class roads, laid out with special reference to military as well as economic needs, came under the supervision of the government-general and were to be four *ken* in width with gradients not to exceed one in thirty. These roads connect the capital (Keijo) with the seats of prefectural governments, divisional and brigade headquarters, principal naval stations and the important ports and railway centres. The second-class roads also supervised by the government-general, are three *ken* in width with gradients not exceeding one in twenty-five. They radiate from the prefectural centres to the seats of district governments, ports and railway stations. The third-class roads, under the jurisdiction of prefectural authorities, average two *ken* in width and connect the prefectural and district centres with the smaller towns and villages in the same jurisdiction. Special roads include all those not in the above classification and come under the control of the particular city or district in which they are located.



Modern Court House

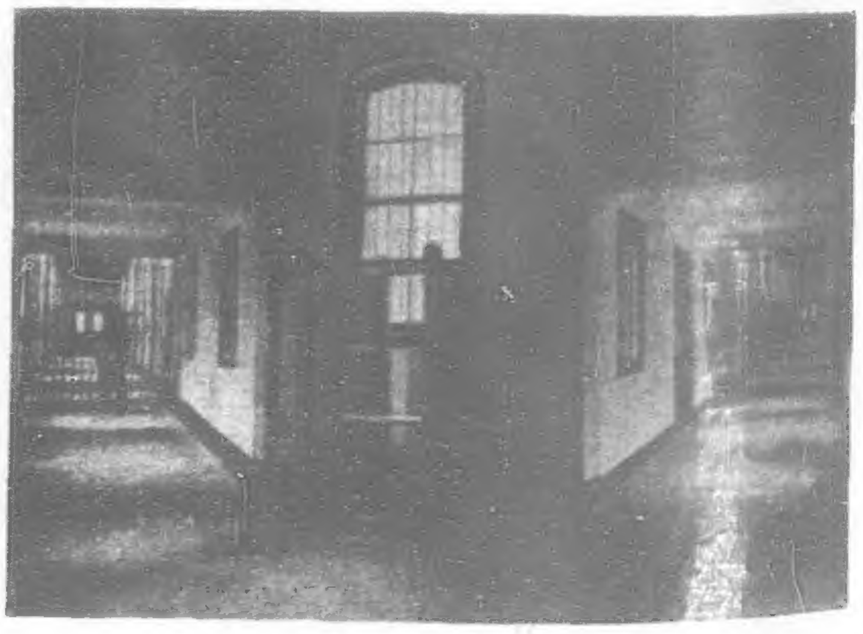
Trial Scene under the Old Korean Judicial System



Old Style Korean Prison

The first road program covering 34 first and second class roads, totalling 685 *li*, was laid down in 1910 and completed in 1917 at a cost of Y. 10,000,000. A second program extending from 1917 to 1922 was then entered into to construct 26 new roads, 478 *li* in length and nine bridges at a cost of Y. 7,500,000. Owing, however, to the rising costs of labor and materials during this period, only 258 *li* were built within the estimate, and to carry on, it was necessary to add another Y. 7,340,000 to the appropriation and modify the program to the extent that work on all unimportant roads was suspended and construction concentrated on new industrial and frontier roads and bridges urgently needed to facilitate the transport of products and defense against the border raids on Korean territory from Manchuria. For this purpose, an additional Y. 4,670,000 was set aside for frontier roads and 8,160,000 for bridges, making the total estimates for the second program, Y. 27,670,000.

Up to the end of 1923 the length of first class roads on the program totalled 794 *li*, second class, 2,394 *li* and third class, 2,849 *li*, a total of 3,188 *li* (first and second class) coming under the supervision of the



New Style Prison

central government. Of this, 2,111 *li* or seventy per cent. of the program was completed. In addition to the road work, 52 bridges with a total length of 6,605 *ken* are provided for. The estimates for carrying out the full program are about Y.77,000,000. Bridge work will be exceptionally heavy owing to the fact that in the first construction program, most of the bridges were hastily erected of wood and are now in a state of disrepair and decay that necessitate heavy repairs or replacement by permanent structures. The life of these wooden bridges is placed at ten years and by the end of 1919, there were 3,276 such structures with a total length of 32,732 *ken* whose replacement would cost Y.15,200,000. With other new bridge construction this would call for an annual appropriation of over Y. 2,000,000 for this item alone. In order to cut down these expenses, new permanent bridges with concrete foundations and piles will be built where the traffic is heaviest and over the deeper rivers which cannot be readily forded in a wheeled conveyance. In the 1922 program the cost of these structures is placed at Y. 8,160,000, with another Y. 15,160,000 for maintenance of existing bridges.

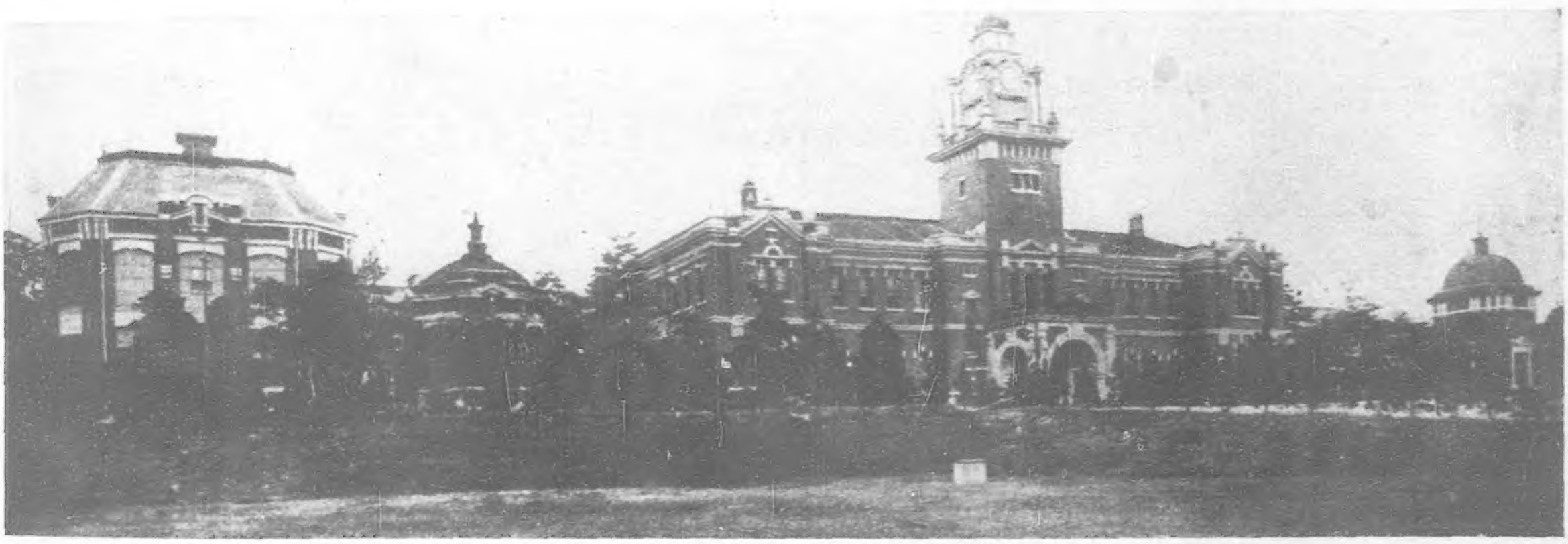
The total length of third class roads on the program is 2,849 *li* of which 1,820 are completed.

has been done for their improvement by straightening, grading, and widening existing streets, and constructing new ones.

Keijo, the capital of Chosen, being different in scale and plan from other towns, it was decided to undertake its street improvement at national expense. Forty-three of its streets were selected for improvement, of which 13 were completed at a cost of Y. 3,000,000 in the eight years from 1911 to 1918. The most important of these were made 12 to 15 *ken* in width and provided with pavements, and where the traffic is heaviest the macadamized surface is tarred, while the other roads were made not less than 8 *ken* in width, thus bringing about an extraordinary change in both the appearance and traffic efficiency of the city.

The second program now being carried out takes in nine streets, the budget estimate for which is Y. 3,400,000 spread over six years from the fiscal year 1919.

Other towns marked out for street improvement are Heijo, Taikyu, Shingishu, Fuzan, Chinnampo, Seishin, Moppo, and Genzan, towns in which provincial offices are situated, and certain others of some importance. The expenditure is defrayed out of the local revenues, sometimes assisted with a subsidy from the national treasury. A few of these towns have already carried out the projected improvements.



In the main, these roads have been built by the local authorities assisted by government subsidies which up to the end of 1920 totalled Y. 2,300,000. At that time the local governments were provided with new sources of revenue and the subsidy was discontinued. In view, however, of the present financial stringency, the government will again be called upon to make further grants in aid of new local road construction.

The increase in the number of wheeled vehicles in Korea is seen in the following figures for the year ending December 31, 1923: Motor cars, 1,088: wagons, 32.161; ox-wagons 79,000; hand carts, 4,647 rickshaws and 92 carriages.

Medical Examination by Korean Doctor (top) and Modern Japanese Hospital Examination (bottom), Government-General Hospital at Keijo (centre)

Street Improvement

Towns in Chosen for the most part contain narrow, dirty, and crooked streets, causing great inconvenience to communications and sanitary and fire-brigade arrangements. Much, however, was pledged to spend Y. 580,000 in 11 years from the fiscal year 1913 to 1923, Keijo, Y. 1,600,000 between the fiscal years 1918 and 1924, and Taikyu, Y. 150,000 in 5 years from the fiscal year 1918 to 1922. Part of the money thus allocated is provided by the national treasury and part by public bodies.

Chosen is still far from being as developed as Japan proper, but the progress made in it being comparatively rapid, it was necessary to lay down a fundamental plan for street improvement, and make the various connected arrangements conform to it, so the government-general has incorporated in the budget an item for investigation regarding city improvement, in four large cities, viz., Keijo, Fuzan, Taikyu, and Heijo.

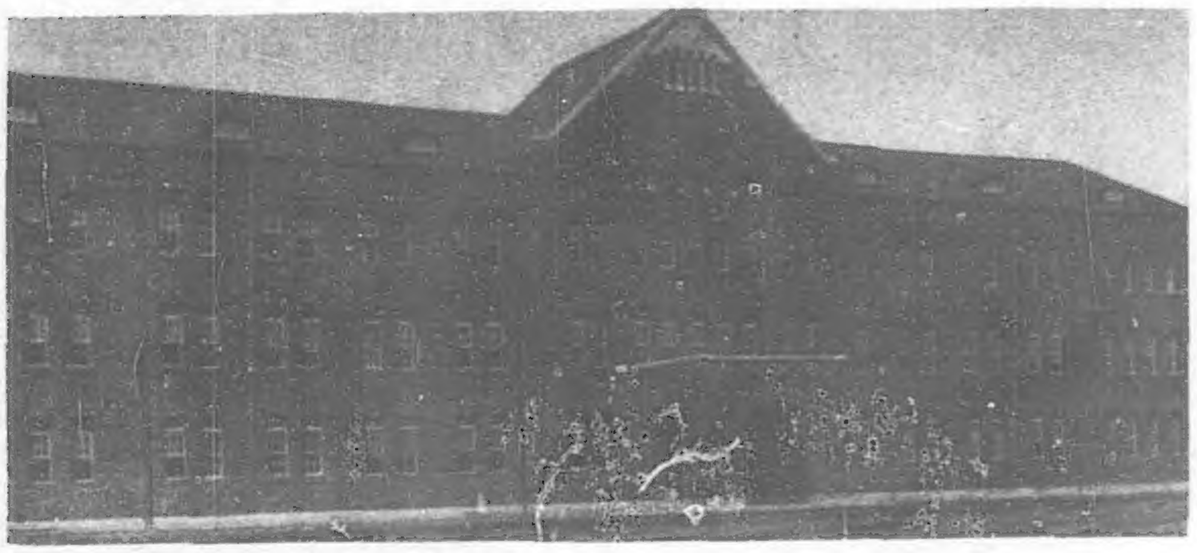
Sewerage

A proper sewerage system is a very necessary aid to sanitation, and it was decided to carry on this improvement side by side with street construction. On this work, the city of Heijo

Modern Waterworks

As the first step towards better sanitary conditions in the peninsula, the Japanese authorities have steadily encouraged the establishment of waterworks. The drinking water throughout Korea

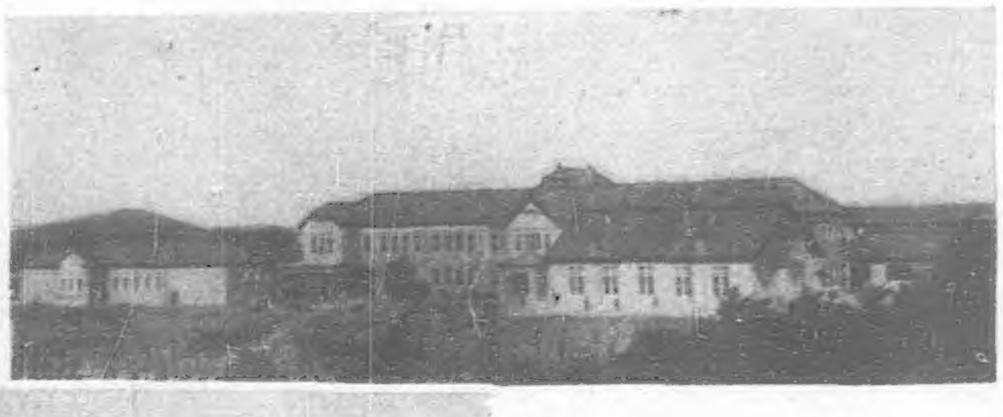
Business School for Koreans



Imperial University, Keijo, Preparatory Course

Japanese Middle School

Heijo Middle School

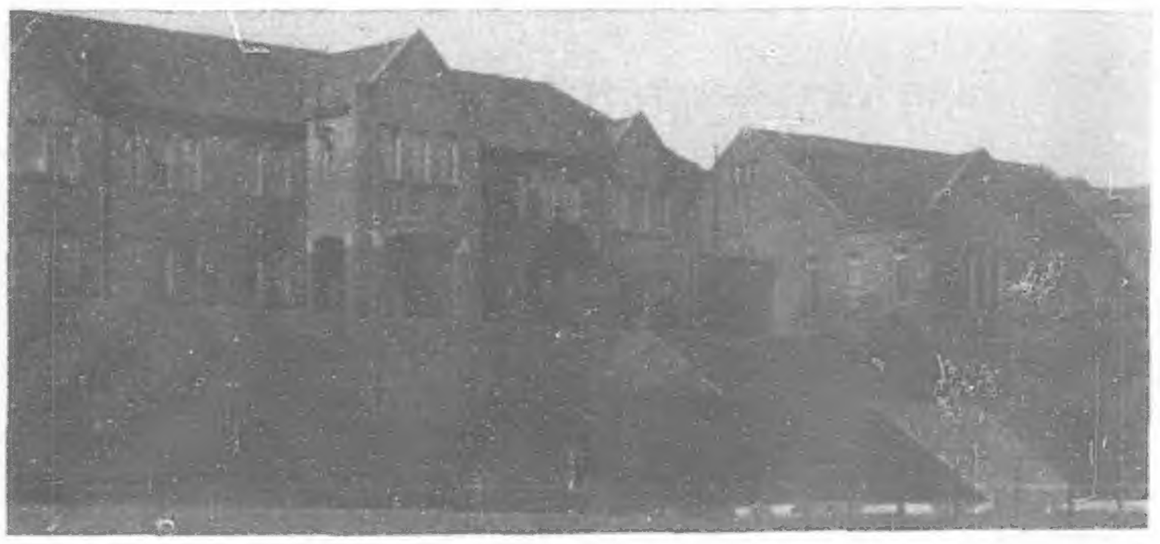


Jinsen Elementary School

Keijo Girls' Higher Common School

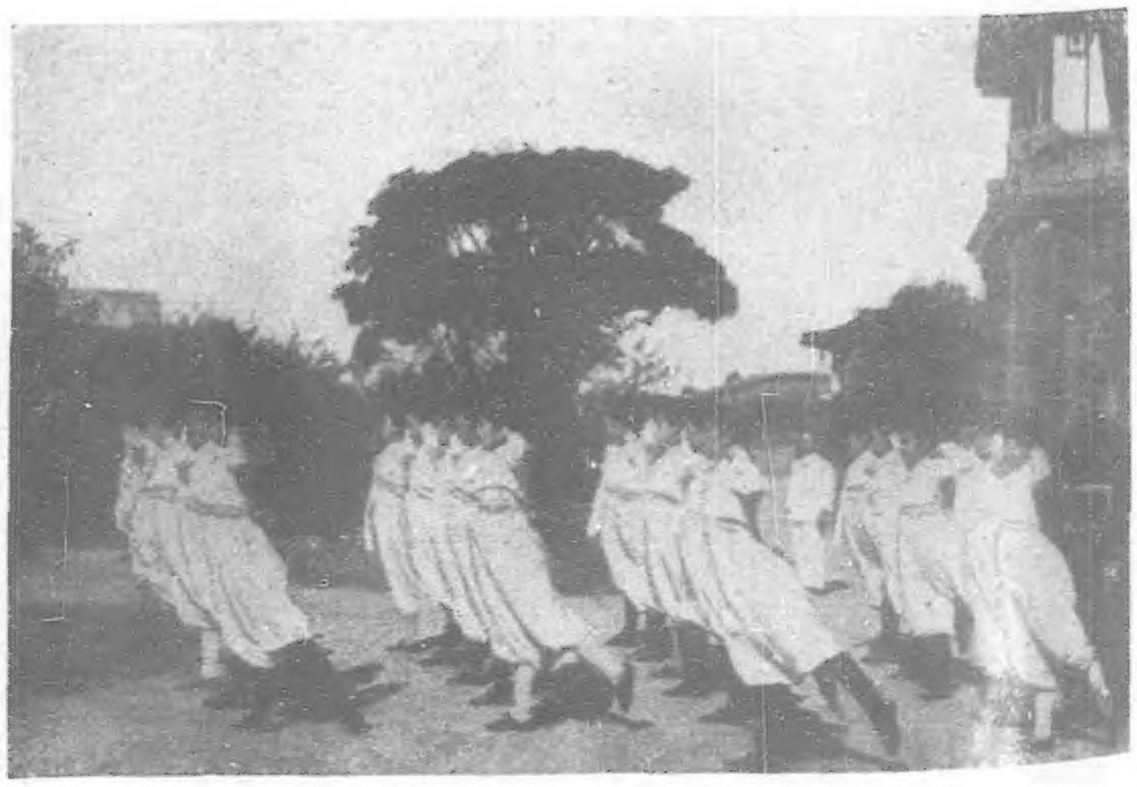
Gensan Girls' High School

Common School for Koreans



Keijo Higher Commercial School

High School for Koreans



Physical Drill in Korean Girls' High School

A *Shado*, the Old Fashioned Korean School House that has been Replaced by Modern Educational Institutions

is in general very hard and filled with impurities, the wells being shallow and easily polluted. In 1915, special waterworks regulations were promulgated in which all new projects had to receive the sanction of the central authorities thus assuring the proper construction of reservoirs, distributing systems and the purity of the water.

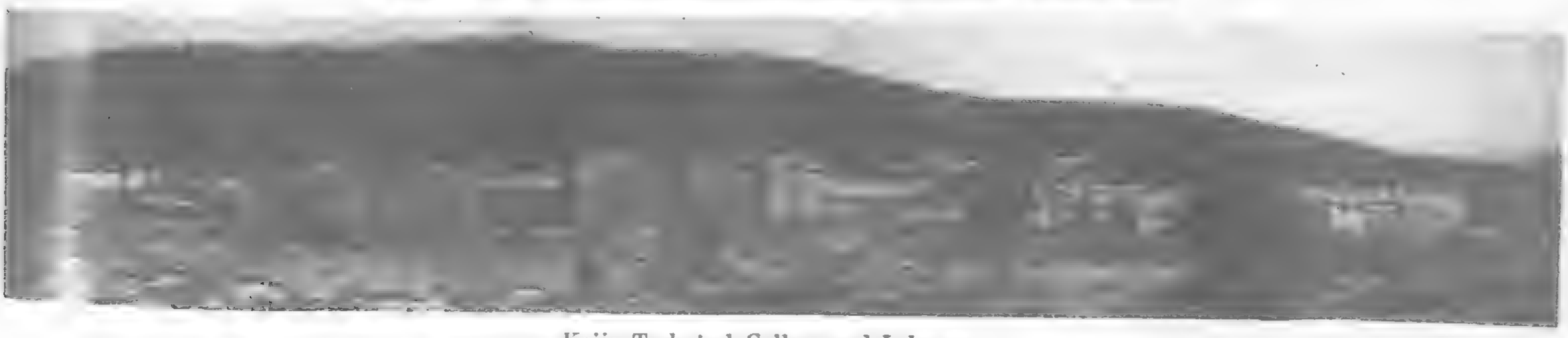
The first modern waterworks were installed before the annexation in Heijo and Jinsen with government funds. These were followed by similar plants at Moppo and Fusan and through its policy of encouragement there are now 26 municipalities operating their own water systems. It is a striking commentary on Japanese colonial government that in many matters it is able to carry out improvements that are difficult to implant in Japan proper. Only 128 cities and towns in Japan were equipped with waterworks by the end of 1921, some of these not even owning their own plant, purchasing their supply from near-by cities. There are still many prefectural cities in Japan without waterworks, yet in ten years practically every prefectural seat of government in Korea has been equipped with modern installations. This is explained in part by the fact that that the water in Japan flowing from the snow-clad mountain back-bone is relatively pure, while in Korea the quality of the water is correspondingly bad.

Few of the cities or towns in Korea have been able to finance these improvements from their own resources, so the central government has provided at least fifty per cent. of the costs of installation from the treasury. These sums aggregate Y. 7,643,537 for the five principal plants at Keijo, Jinsen, Heijo, Chinnampo and Chinkai. In addition, the central government has disbursed about fifty per cent. of the costs of the waterworks for 21 other places aggregating Y. 3,443,699.

Exterior and Interior of Common School in Korea

The government enforces a rigorous supervision over the quality of the water supplied in all cities and towns and is now urging the addition of an analytical laboratory for every plant. At present, the Keijo and Heijo plants are so equipped, the others relying on local hospitals and municipal health authorities to conduct their tests. The Keijo, Heijo and Jinsen waterworks were recently equipped with the chlorination system of sterilization and the government has ordered its installation in all the other plants in the peninsula.

The four waterworks (Keijo, Heijo, Jinsen and Chinnampo) built and operated by the central government were handed over to the municipal authorities in 1922 without compensation and at this date the ownership and operation of all waterworks in Korea are vested in the local authorities. Waterworks are now operating in *Keijo*, *Jinsen*, Gunsen, Moppo, Taikyu, Fusan, *Heijo*, Chinnampo, Shingishu, Gensan, *Seishin*, Koshu, Kaishu, Ranan, Seishu, Koshu, Kokei, Zenshu, Toei, *Shinshu*, Chinkai, *Gishu*, *Kanko*, Hoko, *Shunsen* and Kainei. The names in italics are equipped with pumping stations, all others being operated by gravity. For the present year (1924) waterworks construction has been started at Kinsen, Heiko and Joshin, while extensions are being made to the plants at Chinnampo, Fusan, Kainei, Taikyu and Koshu.



Keijo Technical College and Laboratory

The Power Resources of China

By T. Shing and W. H. Wong in "The China Express and Telegraph"

THE power resources of China are as yet imperfectly known, and as often happens in such cases, the general tendency is rather to exaggerate their importance. New research, however, has been made recently on the mineral fuels making possible a closer estimate of their resources than that generally known before. Some vague indications only can be given on the water-power resources. A general review such as the present one always shows the utter incompleteness of data and the pressing necessity of investigations on the natural resources of such a large country.

Mineral fuel is, and will be still for a long time to come, the principal power resource of China. Solid and liquid fuels will be treated separately.

Solid fuel includes anthracite, coal, lignite and peat.

Anthracite.—Anthracite occurs in many provinces in China. It is generally of carboniferous but in a few cases of Jurassic age. The best-known field occurs in North Honan in Hsiuwu and Tsingyang districts near the Loyang and Honan railway. The field contains an actual reserve of about 800 million tons of anthracite of the best quality. It is now worked by the Fuchung corporation, with an average annual output of about 1,200,000 tons.

This anthracite supplies, mostly for household purposes, the large cities of Hankow, Peking, Tientsin, and the country along the Peking-Hankow and the Loyang-Honan railways. Recently, however, an effort has been made by the Fuchung corporation to induce the Yangtze steamers to give its anthracite a trial; the result seems to be successful. It may be expected, therefore, that, with adaptation to steam-engine construction, the anthracite of which China certainly possesses an enormous reserve will contribute largely in the future to power generation in this country. Other large anthracite fields are found in the Shansi and Hunan provinces.

The actual resources of Shansi are estimated at 2,370 million tons and remain still almost undeveloped. The only important mine is that of the Pao-Ching Co., near the Shansi railway, producing 200,000 tons a year. The Hunan anthracite is exploited only by small native mines and supplies the local consumption and part of the Hankow market.

Coal.—Bituminous coal is now almost exclusively used for all power production in China, including electric generation, steam raising in all industrial works, railway locomotives and marine and river navigation, except for a few oil engines.

Its occurrence is widely distributed all over the country, and its reserve is, though not inexhaustible, quite considerable when compared with immediate demand.

Only coalfields near the railway lines or the large waterways are now being worked on a large scale, those situated ir the interior are not touched except by the small native mines which cannot go down much under the ground water level, and whose output supplying the local demand is always insignificant in comparison with modern mining.

The only important coal mine to be mentioned from South China is the Pin-hsiang colliery in the westernmost part of Kiangsi, connected by branch line to the Hankow-Changsha railway, producing about 800,000 tons per year, which is almost totally consumed by the iron foundries of the Hanyehping company.

A coal which is almost lignite and also extensively worked is that of Fushun near Mukden, operated by the South Manchurian railway administration. It is rich in volatile matter (about 40 per cent.) and tertiary in age. The annual output amounts to nearly three million tons. This coal is used in steamers, locomotives and also in gas works.

Lignite.—Jolainor is the only important mine of lignite in China. It is near the Manchuli station of the Chinese Eastern railway, and its production of about 200,000 tons per year is hardly sufficient to supply the line.

Peat.—Peat occurs in several provinces, but no attempt has yet been made to use it for power generating.

Since the visit of von Richthofen, China's resources in mineral fuel have been reputed as fabulously rich. The estimates given in the "Coal Resources of the World" seem to confirm this opinion, especially Drake's figures, though those given by Inouye were distinctly lower. Recent estimates made by the geolcgical survey of China are, however, much below what was expected, and as they seem to remain still the most reliable to-day.

Comparing the total with the reserves of the principal coal-producing countries given in the "Coal Resources of the World," we see that China's resources form only 79 per cent. of the reserve of Germany before the war, 33 per cent. of that of Great Britain, and less than 2 per cent. of that of the United States of America.

There seems to be no reason to be surprised by this conclusion when we realize that comparison is being made with the three most favored countries possessing the largest fuel resources of the world. The standard of workability is also much lower in China owing to various circumstances, chief among which is the difficulty of communication.

There are also natural factors for this relative smallness of fuel resource; the coal measures in China, though very extensively distributed, are generally less developed in thickness and the coal seams, though sometimes over 2 or 3 metres thick for one individual seam, are as a rule much reduced in number. The carboniferous coal measures in North China are generally less than 300 metres in total thickness and seldom contain more than five workable coal seams.

With a population roughly estimated at 400 millions, we have thus a little more than 100 tons of mineral fuel per head of population. If we suppose that the industrial development in China attains so high a degree that its consumption *per capita* is equal to that of Great Britain and the United States, *i.e.*, 6 tons per head, then our fuel reserve will only last a little more than 15 years. But if we take as the standard the present-day consumption, which is not much over 20 million tons per annum, then our resources will last more than 2,000 years. Of course, neither will be the actual case, and it is clear that China certainly possesses sufficient resources in mineral fuel for a long period of its future industrial development, especially so because these resources are widely distributed, and therefore will be able to supply power in almost every province.

Liquid Fuel

Petroleum is known to occur in several large fields in China, but it remains almost entirely undeveloped. There are three principal fields in Szechuan, Shensi and Sinkiang, which may be of future importance.

Szechuan Oil Field.—Oil occurs in a sandstone and shale formation, probably of Jurassic age, below the red sandstone which is so widely spread in that province. There are, within the great basin of Szechuan, so far as known, two anticlinal zones which are favorable to oil accumulation. One is the zone striking E.N.E.-W.S.W. from the north of Weiyuan and Hsiunghsien districts to a region situated on the Ming-kiang river, between the two districts Loshan (formerly Kiating) and Kienwei. It is in this latter region that oil is especially encountered by salt wells sunk through the red sandstone to a depth varying from 250 to more than 2,000 feet, and a second zone is parallel to the first but of much shorter extent. This elongated dome-shaped structure occurs in the Kungtsing and Tze-liu-tsing region, which is well known for its salt production. This region covers an area of 20 kilometres long in a E.N.E.-W.S.W. direction, and about 5 kilometres wide in a N.N.W.-S.S.E. direction. The salt wells, estimated at thousands, are especially centred along the axial line, and encounter several oil-bearing strata respectively at 1,700, 2,000 and 3,000 feet. The quantity of oil extracted is, however, scanty, and averaged, at the time of the visit by Louderback in 1914, at 250 catties per day, equivalent to no more than 50 tons in weight per year. No special effort has been made for investigating the oil from the native wells which are sunk only for brine. In the same formation which are sunk only for brine and which contains the oil, occurs the gas, which is sometimes, especially at the 3,500-feet level, quite abundant, and used for heating more than 6,000 brine evaporating pans.

Shensi.—North of Wei-Ho valley occurs a great basin of Mesozic sediments. The oil-bearing formation is called the Shensi series, and is probably of lower Jurassic age. It is a thick series of sandstone and shale extending from the Yellow River on the Shensi and Shansi border, dipping very gently westward at an angle of a few degrees. During 1914-1915 six borings from 2,000 to over 3,500-ft. in depth were sunk in the Yencheng, Tsung-pu and Yenan districts at the points where the structure seems to be the most favorable for oil accumulation. Several oil-bearing strata were encountered, but in relatively insignificant quantity, with the possible exception of the first boring in Tsung-pu district, in which more oil occurs at the level of 1,378 feet. Before these borings were undertaken by the Chinese government, with the co-operation of the Standard Oil company of America, four wells were sunk in Yenchang of the eastern border of the Shensi oil field by a government bureau. Two of these wells struck oil at 210 and 270 feet respectively, and each yields a daily output varying from 300 to over 400 catties. The oil thus produced is only used for local lighting purposes.

Sinkiang (or Chinese Turkestan).—The geology of Chinese Turkestan is yet very imperfectly known, but promising oil resources seem to exist over a wide area. Oil-bearing strata occur in the so-called Kansu oases between the Lungshan and the Nanshan ranges. Oil is extracted in small amounts for local lighting and heating purposes. In Sinkiang between the Altai and the Tientshan ranges, in several districts, such as Tihua (formerly Hurumtzi), Suilai, Usu and Tahcheng, quite a number of oil springs are known to exist, and attempts have been made to extract the oil by shallow wells. The best wells in Suilai and Tahcheng are said to have yielded more than 200 catties per day.

From the above outline it is clear that oil resources exist over wide areas in China. The fact that so far no particularly rich area has been known is due either to the absence of favorable structure necessary for the local concentration or simply to the lack of research. It may be hoped that the liquid fuel, when better utilized, will contribute one day its part to the power production of the country.

Water Power Resources

No waterfall of first magnitude comparable to the Victoria Falls in South Africa, and the Niagara Falls in North America is known in China. Falls of ordinary size are, however, not rare. Most of the large rivers abound, in their upper course, in rapids and waterfalls of which no accurate survey has yet been made. With the actual state of our knowledge, it is therefore impossible to form an exact idea of the water-power resources in China; only a very general outline can be given here.

As a rule, water power is less abundant in North China than in South China because of smaller rainfall and smaller quantity of water in the north. River courses are, however, often cross cut by abrupt changes of altitude resulting the formation of rapids, these changes being due either to the normal fault displacement or to the outcrop of rock formations of notably unequal resistance. Thus, in the N.-S. course of the Yellow River between Shansi and Shensi provinces, there are several rapids, among which the best known is the Lung Men rapid. The whole volume of the Yellow River water is concentrated at that section in a narrow width of 50 metres, and flows down to the lower channel with enormous quantities of spray visible at a great distance. Such a waterfall would be an important source of power if properly developed. No other fall comparable to this one is found on the upper course of the Yellow River until Western Kansu is reached.

Besides the waterfalls, which are rather rare in North China, there is another kind of topographical feature which may be of importance for future power production. The rivers often wind their way sluggishly through the plains. When the bends are very sharp it would be easy to cut off the arc artificially, and have the river course thus shortened so as to produce a considerable waterfall. The case would be the same if instead of a closed loop of the river, the upper course of an open one were tapped by a tributary of the lower course. One illustration may be mentioned in Western Chihli, where the River Chumaho makes a big bend northward between Tzuching-kuan and Laishui district. A short artificial channel near Tzuchingkuan would be sufficient to have the Upper Chumaho captured by the River Yishui with a great fall of water.

In South China falls and rapids are rather common in the mountainous regions of the western provinces and on the north and south slopes of the Nan-ling range, though no quantitative data are available. Falls or rapids occur where the river cut across rocks of unequal resistance, such is the case with the upper course of many rivers in Yunnan and Szechuan. In Kuei-chow province, the prevailing feature is a high plateau composed of almost horizontal strata. Water often flows down from the top of the plateau to the deeply entrenched valleys; cataracts are thus formed.

In North Manchuria, where the plateau is covered by volcanic lava flow, waterfalls also often occur—when the lava gives rise to abrupt change of height.

In conclusion, little is known definitely about China water-power resources. But it may be expected to be quite important so far as we can judge by a study of the topographical conditions. Such resources have never yet been utilizd for producing any mechanical work except in the crude water wheels which have existed for centuries, and yet almost everywhere it would be practicable to utilize power.

Electrical Development

The growth of electrical installations in China has been very rapid in the last few years. A recent review gives a total of 205,000 kw., including the 120,000 kw. of Shanghai. By far the largest part of the power is used for lighting, but in large cities such as Shanghai electrical power is also increasingly used for industrial and manufacturing purposes.

Coal is exclusively used for electric power generation. Nowhere has hydro-electric power been developed.

Hongkong's Water Supply

The Enormous Shing Mun Valley Waterworks Scheme

THE Hongkong public works department have devoted considerable study, for some years past, to the growing requirements of the colony as regards water supply. In general principle it was decided to adapt the Shing Mun valley on the mainland as a huge reservoir, and from thence to pipe line the water, via tunnels and lines under the harbor, to the island.

The first section of this great scheme has now been commenced by the placing of a contract, in open competition, with the civil engineering department of Sir W. G. Armstrong Whitworth & Co., Ltd., whose engineers are now established and working on this contract in Hongkong. The value of this contract for the first section represents some $1,100,000.

The work involved in the remaining portions of this projected public works scheme will amount to a value of over $18,000,000.

The contract which has now been placed with the Armstrong Whitworth Company, provides for all supervision, labor, materials, plant, tools, and equipment required for the execution of the following work:—

(*a*) The driving of a tunnel some 2,160-ft. long and 9 by 8-ft. section, for the purpose of carrying water through the "Smuggler's Ridge" hill.

(*b*) The driving of a tunnel some 4,680-ft. long, and the same section, through the "Golden Hill."

(*c*) Excavations of loose and solid rock in opening out the mouths of the tunnels, and the necessary tunnel portals of granite ashlar.

(*d*) The construction of a concrete conduit, known as the "South Conduit" some 2,000-ft. long, connecting the above tunnels.

(*e*) The construction of a gauge basin and other works at the south end of the south tunnel.

It can be readily understood that when this great scheme is entirely completed, that the colony of Hongkong will have one of the finest water reserve and supply systems extant in the world.

S.M.R. Sulphate of Ammonia Factory at Anshan, South Manchurta

Chemical Manufacture in Manchuria

THE South Manchurian Railway, organized in 1906, with an authorized capital of Y.200,000,000, since increased to Y.440,000,000 (£44,000,000), one-half of which is owned by the Japanese government, has in the few short years that have elapsed brought immense prosperity to the country. Development on the most modern and up-to-date lines has been the policy of the company, and it has one of the richest soils in the world on which to carry out its operations.

Progressive Policy of the South Manchurian Railway

One of the railway's first moves was to encourage the better class of Chinese and Japanese farmers to settle in Manchuria. They promulgated a scheme by which the land could be obtained on most advantageous terms, they established agricultural experiment stations at various points, as well as a central laboratory and a geological institution in the city of Dairen. At the experimental stations innumerable trials were made with a variety of cereals and trees. To the soya bean, of course, speeial attention was paid, with the result that the crops scientifically grown from specially selected seed, were far more prolific than ever before. The war, with its demand for enormous amounts of soya bean products, greatly assisted the industry, and the record prices received so encouraged and stimulated production that the latest available statistics show that no less than 33,585,000 acres are under cultivation in Manchuria and Eastern Mongolia, the figures of the latter country being 6,410,000 acres. In addition to that there is a further estimated area of 42,500,000 acres of magnificent arable land yet awaiting development. The land being reclaimed is calculated at about a million acres a year.

Inui Alkali Works, Dairen

Scientific Research Institutions

The central laboratory, originally established by the Kwantung government in 1908, was taken over by the railway two years later. The work was reorganized into eight divisions : analytical chemistry, applied chemistry, tussah spinning, dyeing and weaving, pottery, brewing, sanitation, electro-chemistry, and general. It was provided that for any enterprise promising to be commercially profitable an experimental factory might be set up, and that when any experimental factory reached the commercial production stage it should be turned over to a business company to operate. In this way a tussah silk spinning works was established in 1910, followed by earthenware and porcelain factories, and a fire brick kiln. Later a sorghum alcohol distillery, a dyeing and weaving works, a bean mill employing solvent extraction methods, and a fatty acid factory were organized. Still later there was added a glass factory and a lignoid factory.

The experimental soya bean mill, with its fatty-acid factory, was transferred to private management in 1915, upon the completion of the series of experiments for which

Coke Works and Sulphuric Acid Factory at Fushun

it had been established. Bean milling ranks foremost in Manchurian manufacturing industry, but only within the past few years, since the South Manchuria Railway inaugurated its campaign of industrial development, has the soya bean and its varied products become of importance in world trade.

Improved Soya-Bean Product Technology

Native oil mills are found everywhere in Manchuria—over 200—in all—and in these the cake is ground by mules or donkeys and

Electro Chemical Company, Fushun

Mukden Chemical Works

the oil is expressed by hand labor. The Japanese introduced power presses, driven by steam, electric, gas and water power, and most of the modern mills are of this type.

A much more efficient solvent-extraction method has lately been developed through the railway's research department. Benzine is used, and not only is there no waste of oil, but the residue, in this case not in the form of cake but in bulk, is better fitted for fertiliser. By the expression system 133 pounds of beans give about 12½ pounds of oil and two pieces of bean cake each weighing 61 pounds. By the chemical extraction system the same amount of beans usually gives 17½ pounds of oil and 106 pounds of meal. In Dairen alone there are more than 60 mills producing 390 tons of oil and 3,700 tons of cake a day.

To facilitate the shipment and marketing of soya beans the company has organized a "mixed storage system." The beans are divided into four classes, according to colour—yellow, white eyebrow, green and black. The chemical composition according to analyses made in the Dairen central laboratory, is as follows (the figures show percentages) :—

	Moisture.	Albuminoids.	Oil	Carbohydrates.	Fibre.	Ash.
Yellow bean ..	9.11	39.90	17.59	24.27	4.92	4.21
White eyebrow	12.34	37.35	17.37	24.36	5.12	4.36
Green bean ..	12.64	36.47	16.23	25.08	4.89	4.69
Black bean	10.74	35.32	15.80	24.43	5.96	4.00

Fermentation Industries

The staple food of the Manchurian population is kaoliang, a variety of sorghum, which is also the principal food of the numerous animals engaged in farm work and the carrying trade. The annual production in Manchuria is about 180,000,000 bushels. Next to kaoliang, millet is the chief article of food. The distillation of alcoholic beverages for domestic consumption from the above cereals has always ranked as an important native industry. The liquors used by the Chinese are chiefly shumshu (sorghum alcohol), distilled from kaoliang, and huangchiu from millet. Both beverages are very similar to whisky. The output is worth about Y.13,000,000 (£1,300,000,) per annum.

The United States department of agriculture, in a recent report, made the following statement :—"The rapid rise of the soya bean to a crop of special importance in the world's commerce in the past few years is one of the most remarkable agricultural developments of recent times." The first shipment abroad was made in 1908 by the Japanese firm of Mitsui & Co. with 100 tons to London. With its very high percentage of protein (40 per cent.) the soya bean has been characterised as a "modern manna." Apart from the oil which goes largely to the United Kingdom, the United States and generally to the continent of Europe, the beans are exported mostly to China and Japan, and the bean cake to Japan.

Miscellaneous Chemical Products

Large quantities of starch are made from soya beans, kaoliang and potatoes. Hard oil, stearine, glycerine, and soap are produced from soya bean oil, and the Mukden Chemical Company is producing considerable quantities of gelatine and animal and vegetable oils. The cereal, kaoliang, as a result of the railway's research work, has become useful in many ways. Calcium lactate is an important by-product. Lactic acid is made from the calcium lactate and is used extensively in fermentation, dyeing, tanning, and other industries. The manufacture of paper from kaoliang pulp is another growing industry. From the ash of the stalks potassium salts are obtained for the manufacture of glass, medicines, fertilisers, and other products.

The "Salt Gardens" of Manchuria

Over the Yellow Sea and the Gulf of Pechili there is little rain and evaporation goes on actively. Therefore, the sea water is a more concentrated brine than usual, and salt manufacture is conducted very extensively along the sea coasts. At Yingkou, Kaiping, and Fuchou, the "salt gardens" under the management of the Chinese government and private individuals lie in an almost unbroken line. The sea water is forced into the "gardens" by means of the tide and windmills, and is left to evaporate in the sun. The salt industry is also conducted vigorously in the Kwantung leased territory. The yearly Manchurian output averages 150,000,000 bushels, of which about one-quarter is from Kwantung. Salt is a monopoly of the Chinese government. The government buys salt manufactured along the sea coast and sends it to different centres to sell at a specified price. The import of salt into Manchuria is forbidden. Salt produced in Manchuria is debarred from export, except to Mongolia and the Jehol district, but Kwantung salt is exported to Japan and Chosen.

Natural Soda and Other Minerals

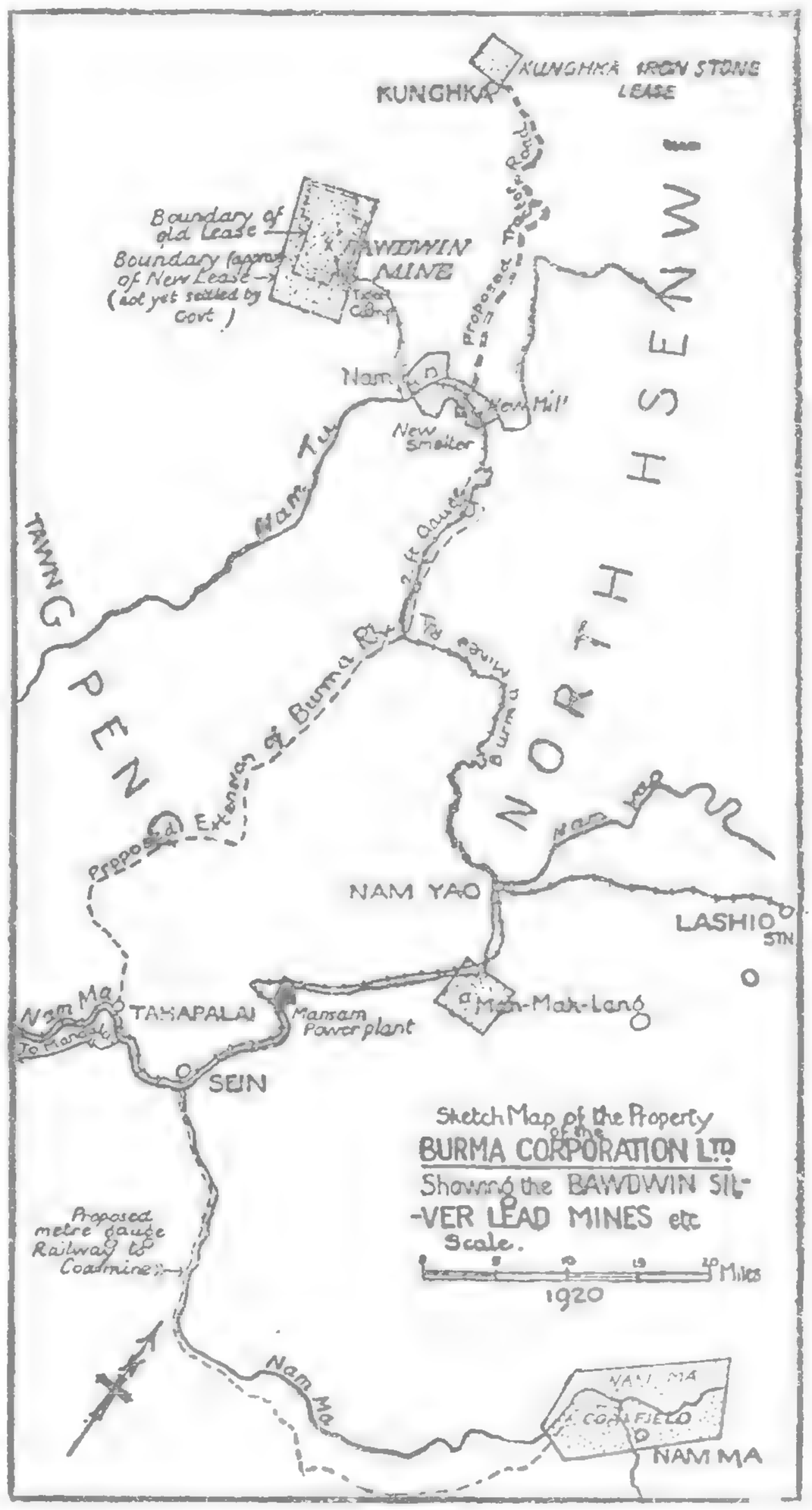
In Eastern Inner Mongolia there are large deposits of natural soda. The low plains, lakes, and swamps become white in the dry seasons (spring and autumn) and sometimes the soda forms in layers and presents a beautiful sight. Natural soda is worked at the native soda depôts. From spring to summer crude soda is compressed into brick from, and form autumn to winter crystallized soda of comparatively fine quality is obtained. Manchuria abounds with limestone which usually contains more or less magnesite. Near Tashihchaio a magnesite deposit of exceptional dimensions has been discovered. It has proved excellently suited to the making of fire-bricks and is now supplied to the government steelworks at Edamitsu, Japan, and to the Anshan steelworks. Talc, mica, fluorspar, sulphur, nitre, felspar, and silica are also found in considerable quantities throughout Manchuria, and the geological institute is using every means to encourage the development of these resources.

The Bawdwin Mine, Northern Shan States

THE only important deposit of silver-lead and zinc worked in India is the Bawdwin mine, in the Northern Shan State of Upper Burma. The extent of the deposit has already been alluded to a previous article and it will suffice to say that development has proved it to be one of the greatest leadzinc orebodies in the world, to say nothing of possibly very important copper potentialities.

The ore channel, cutting across a formation of rhyolitic tuffs of pre-Cambrian age, is an extremely faulted zone, fully 8,000-ft. in length and with a width of 400 to 500-ft. Within this zone three important orebodies are known, only two of which are at present opened up—namely, the western or Burma orebody, containing a thin vein of silver-lead ore, and a large replacement deposit known a the Chinaman lode, extending for a length of at least 1,200-ft. and varying in width from a few feet to over 100-ft.

The central orebody, known as the central or Shan lode, lies parallel with the Burma, and carries copper as well as silver-lead and zinc ore. Geological examination suggests that orebodies may be reasonably expected to extend throughout the whole length of 8,000-ft., and as far to the south as the rhyolitic tuffs extend. Indications are not wanting that exploration in a northerly direction may possibly expose large deposits of copper ore.



Early Smelting Operations

The attention of Europeans was first attracted to the Bawdwin mines by huge piles of rich lead slag, low in zinc, from which the Chinese had removed the silver, in some cases, perhaps, centuries ago. A smelter was erected at Mandalay in 1908, and a narrow-gauge railway constructed from the mine to the Lashio-Mandalay branch of the Burma Railway to convey the slag to the smelter. During 1911 the smelter was moved to Namtu, and subsequently, as the slag left by the Chinese began to be exhausted, the plant commenced operations on the ore itself, which was discovered by exploration of the old Chinese workings.

This ore consisted entirely of sulphides, which necessitated roasting before it could be successfully smelted, and output was limited at first by the capacity of the roasting plant. Roasting was originally effected in six Godfrey furnaces, each capable of treating 40 tons in 24 hours and reducing the sulphur contents of the ore to 10 or 11 per cent. These furnaces were used as preliminary roasters, the partly de-sulphurised ore being subsequently sintered in Huntingdon-Heberlein pots, and the sulphur content was further lowered to about 4 or 5 per cent. Additions to the roasting plant have been made from time to time, and during 1918-20 a concentrating mill was erected at Namtu with a nominal capacity of 1,500 tons of ore per day.

Mining Developments

The early history of the European development of the mine is one of a continued struggle against many difficulties. The old workings left by the Chinese were in a deplorable condition, many being caved-in and filled with water.

One of the drives just missed the Chinaman lode, and the second was driven straight through a big fault between the Chinaman and the Shan lodes. After two years of strenuous and discouraging work the main orebody was struck by what is now known as Dead Chinaman's Tunnel (No. 2 level). From that time onwards development was rapid, and to-day the Chinaman orebody is considered to be one of the largest high-grade silver-lead-zinc orebodies in the world. The ore reserves are quoted below, but it may be stated here that in addition there are probably another million tons or more of lower grade ore (8—20 per cent. combined Pb and Zn), of which account has been taken.

The ore occurs as solid masses of sulphide without admixture of gangue. On some levels the orebody averages 50-ft. in width for a continuous distance of 1,000, and in a few places is 100 to 140-ft. wide, and may carry upwards of 75 per cent. zinc and lead sulphide.

The mine has been systematically developed down to the 653-ft. (No. 6) level or main adit known as Tiger Tunnel, which is about two miles long. This tunnel is 7,369-ft. long to the [illegible] shaft, with a volume capacity of 662,850 cub. ft. It was started in April 1914, and completed in September 1916. There are two sets of rails, and the trolleys that haul the truck-loads of ore are worked by electric current conveyed by overhead wires. Very little hand work is employed in the mine. Six levels are already being worked, and a seventh is in process of development. The ore is blocked out by a series of crosscuts, from which rises have been put up every 100-ft. All the ore from the various levels is dropped to the 6th level, where it is loaded into 4-ton trucks and conveyed to Tiger Camp.

The seventh level is showing extremely satisfactory results, four crosscuts disclosing ore widening out from 14½-ft. to 77-ft. from the first to the fourth cut. Both lead and silver contents are above the average of the reserves, and a very favorable feature is the large diminution in zinc content, an important factor in the subsequent treatment of the ore. This

decline in the ratio of zinc to lead has been noticeable from the fourth level downwards.

Rapid progress is being made with the main circular shaft; the old vertical shaft is being stripped to No. 6 level to a circular section, 14-ft. internal diameter, with masonry lining. It will be divided into three main compartments—two for skips and one for a large cage, with two smaller compartments for counter-weight, pipes, cables, and manway.

At Waller Gorge, Tiger Camp, huge ore bins have been erected, into which the ore is fed by a 29-in. belt conveyor. The ore is subsequently taken by trains to the Namtu smelting plant.

Smelting Plant Blast Furnaces

Hydro-Electric Plant

The electric power supplied to the plant and mine is entirely derived from the Mansam Falls. The Falls themselves constitute one of Nature's beauty spots, and are fed by the Nam Yao River, which plunges in a series of giant steps down to the Burma corporation's power house situated at the bottom of the valley. Electricity is transmitted at 33,000 volts to Namtu and Bawdwin. The transmission line is supported on 250 steel towers on the Mansam Falls, Namtu section, a distance of 26 miles, and from Namtu to Bawdwin (12 miles) there are over 70 towers. A new sub-station has recently been completed at Namtu, and three new 700 k.v.a. transformers put into commission. The old transformers have been re-erected at the smelter sub-station, and are fed direct from the 33,000-volt mains.

During the past year over 20 million units have been generated at the Mansam hydro-electric plant, which not only supplies the mine, milling, and smelter equipment, but is also employed for lighting the company's settlement at Namtu.

Water Supply for Dressing Plant

The operations carried on at the mill call for a large supply of water, which is obtained either from pumps at the Namtu river, half a mile away, or from a flume which taps the Namla river on the other side of the Namtu valley. Near the mill site there is a large concrete-lined reservoir with a capacity of about 3,000,000 gallons, in which the water used is stored.

Present Smelting Plant

The smelter has been recently remodelled, and the main units of the smelter plant now comprise the following:—

Five Godfrey roasters, used for the preliminary calcination of the ore.

Four primary Dwight-Lloyd sintering machines.

Three secondary Dwight-Lloyd sintering machines.

Twenty-nine Huntingdon-Heberlein pots.

Five blast furnaces, with the accessory blowing plant.

Refinery and silver room plant, having a maximum capacity of about 4,000 tons of refined lead and approximately 500,000 ozs. of silver per month.

A new smelter flue has been added to the plant within the last eighteen months—the occasion of an opening ceremony by H.E. the governor of Burma—and has effected the greatest improvement to living conditions in Namtu, the smoke and fume being carried clear of the settlement, to the benefit of all classes of inhabitants.

The concentrates sent to the sintering plant run about 40 per cent. lead, with 37 ozs. of silver per ton, 22 per cent. of zinc, and slightly over .5 per cent. copper, with a similar amount of nickel.

About 25 per cent. of iron ore (derived from the Wetwun district and Namphat) is added, and the mixture roasted in the Godfrey furnaces. It is subsequently sintered in the Dwight-Lloyd plant or Huntingdon-Heberlein pots.

The use of the Dwight-Lloyd sintering machines is invaluable, not only in increasing the tonnage of ore put through the blast furnaces, but also in lowering the sulphur content and consequently improving the running of a high zinc charge.

The blast-furnace slags previous to 1918 had carried about 15 or 16 per cent. zinc oxide; a small amount of matte was produced, and occasionally speiss containing 25 to 30 per cent. nickel. An effort was subsequently made to run a slag with a higher zinc content, and the slags at present produced carry no less than 25 to 26 per cent. ZnO.

The limestone required for such a slag is much less than had previously been the case, and against the increased percentage of FeO in the slag must be placed the lessened quantity of slag actually produced.

During 1922 over 200,000 tons of charge were smelted, including refinery drosses nd settler slags, having an average assay value of 28.6 per cent. lead, 14.3 per cent. zinc, and nearly 27 ozs. silver; 42,000 tons of hard lead were obtained from the smelting of the ore, over 7,000 tons from refinery drosses, and nearly 700 tons from settler slags—a total of 50,374 tons. The lead averaged 103 ozs. of silver per ton.

During this period over 1,000 tons of copper matte and 1,000 tons of nickel speiss were produced in the furnaces, which is stacked for futuer treatment.

Nearly 25,000 tons of coke were used in the blast furnaces, equivalent to 12.36 per cent. of the charge. The amount of slag and the analysis of same will be of interest to our metallurgical readers. The figures are as follows: Slag produced, 94,060 tons. Analysis (approx.)—SiO_2, 23.06 per cent.; CaO, 5.85

Terminal of Railway to the Bawdwin Mines

per cent.; FeO, 30.81 per cent.; ZnO, 25.83 per cent.; Pb, 3.65 per cent.; Al_2O_3. Mgo, etc., 10.80. Silver, 1.07 ozs. per ton.

Refinery

The capacity of the refinery has been enlarged to cope with the increased output from the blast furnaces, and the disposition of the units so arranged that further extensions can be made as required without interruption to current operations. Many minor improvements have been effected, and the refinery may now be considered a very satisfactory and compact unit.

Oil fuel has been used with highly successful results in the refinery, and has now entirely displaced the wood fuel formerly used, supplies of which were running low and the cost high. Chinese workmen quickly became accustomed to the use of oil, and regulated the heat better than was possible when using the very variable wood fuel cut by the coolies.

51,869 tons of hard lead from the blast furnaces were treated, giving a yield of 39,214 tons of refined lead, and no less than 4,205,584 ozs. of refined silver were obtained during the period under review.

It is of some interest to compare the figures obtained during 1922 with those of 1923—taken over two periods of six months each :—

	Jan.-June 1923.	June-Dec. 1923.
Hard lead produced ..	27,842 tons	12,417 tons
Refined lead obtained ..	21,654 tons	11,598 tons
Refined silver obtained	2,274,441 ozs.	1,296,152 ozs.

The analysis of the slag remains singularly constant, SiO_2 contents averaging 23.33 per cent., CaO 6.29 per cent., FeO 31.22 per cent.; ZnO is slightly higher at 26.54 per cent., and the silver content is identical at 1.07 ozs.

Ore Reserves

The following table shows the estimated ore reserves and the assay value of same for 1921-1923 :—

	Tons	Lead. Per cent.	Zinc. Per cent.	Silver. Ozs.
December 31, 1921 ...	4,290,358	25.1	17.5	23.9
December 31, 1922 ...	4,555,069	25.4	17.1	22.9
July 1, 1923	4,511,999	25.3	16.9	22.8

Mining Settlement and Improvements

The Burma Corporaton's mining settlement at Namtu has a population of approximaterly 20,000 people, of whom about 150 are Europeans and Australians. The town, together with the smelter where the ore is treated, lies in a large hollow in the midst of one of the many clusters of hills on the western boder of Hsenwi state. The European residential quarters extend from the southern side of the hollow and over the hill, on the crest of which stands the general manager's bungalow. A bird's-eye view of Namtu is obtained from the hill on which the European members of the staff reside. Chinese laborers' quarters extend from the bottom of the hollow and over to the right, while on the left is the smelter. Behind the smelter, and clinging to the face of the steep hill which forms the further side of the hollow, is the new flue. This new flue is intended not only to take away from the immediate surroundings of the workers the destructive sulphur and lead fumes accruing from the smelting process, but also to recover an appreciable percentage of the lead which is at present being carried away and deposited on the adjoining countryside.

It is not many years ago since Namtu was a part of the country a visit to which would not have been anticipated with feelings of joy. It was fever stricken, dangerous to travel and work in and forbidding in many ways. But such obstacles to the development of industry in a country had been overcome elsewhere, and it was not with feelings of despair that the staff of the company then conducting operations set to work to rid the countryside of its perils, natural and otherwise. Now, as medical statistics show, it is a health-giving place, and is as free from malarial fever and other diseases as is Rangoon.

The Burma Corporation has much to be proud of, and has done much for the development of the mining and allied industries in Burma. We can emphatically reiterate Sir Harcourt Butler's sentiments with regard to this company by quoting his own words: "The great need of Burma, as of India, is to attract capital for its development. I am one of those who hope and believe that in increasing measure Burman and Indian capital will come forward to follow in your pioneering footsteps. If once the industrial science of the west and the resources of the east really join hands, there should be little limit to progress in this land so rich, so favored by Nature."—*Mining Journal.*

New Twin-Screw Shallow Draft Yangtze River Steamer

THE Hongkong and Whampoa Dock Company, Limited are building at their works at Kowloon a new twin-screw shallow draft river steamer for the Hankow-Ichang service of the Indo-China Steam Navigation Company, Limited. This vessel will have the following dimensions :—

Length overall	285′ 0″
Length between perpendiculars ..	275′ 0″
Breadth moulded	46′ 0″
Depth moulded	11′ 0″ to main deck

The vessel has two complete decks, with bridge deck amidships and boat deck aft, and is divided into six W. T. compartments by five transverse bulkheads, and has a deadweight carrying capacity of 1,330 tons on a draft of 9-ft. 0-in.

Cargo is carried in the fore and aft holds and also in the 'tween decks. The latter will also be required for deck passengers. The facilities for working cargo consist of twin masts forward and derrick posts aft, the forward derricks being capable of lifting loads up to 10 tons. Two winches are provided for each hatch, also two small wall winches.

The rudder is controlled from the bridge by the McTaggart Scott system of Telemotor gear, which is led to Hastie's steam steering gear, directly coupled to the rudder head.

A powerful steam windlass is fitted for working anchors and cables, a warping capstan being fitted aft.

The ship will have accommodation amidships for twelve 1st class passengers in six commodious staterooms, each having two cot beds, and a continuous supply of hot and cold fresh water. The usual electric fans and radiators will be provided. The dining saloon situated just forward of the cabins, will have seating accommodation for twenty, and will be handsomely fitted out in teak, set off with carved and polished hardwood pilasters. A smoke room will be constructed at the after end of the bridge deck.

Accommodation for 2nd class passengers will be provided on the aft boat deck, where there are nine 4-berth cabins and a large dining saloon.

The captain's quarters, consisting of bedroom, sitting room and bathroom, will be situated just abaft the navigating bridge, the officers and engineers being housed amidships on the upper deck.

The vessel will be electrically lighted throughout and fans and electric radiators will be provided in all public, passenger and officers' rooms.

The vessel will be propelled by two sets of triple-expansion engines, having cylinders 13½″—22″—35″ with a stroke of 18-in. Steam is supplied by two Thornycroft watertube boilers, designed for a working pressure of 250-lbs. per sq. in. The boilers are arranged for coal fuel only, with the Howden's system of forced draught.

The engine room will be equipped with auxiliary machinery of the most modern pattern, consisting of one Uniflux type condenser with steel body, monotype air pump, 2 independent main feed pumps and heater, evaporator, centrifugal circulating pump, independent bilge, sanitary, fresh water and ballast pump. The reversing engine will be of Brown's latest make, and the thrust block of the Michell type and a Crompton's ash hoist will be fitted.

Electrification of the Imperial Government Railways of Japan

H. C. Hickock*

THAT the Imperial Government of Japan has definitely decided upon on a general program of electrification for its trunk lines is a fact of considerable significance. The government railways comprise some 9,000 miles of track and include more than eighty per cent. of all the railway trackage on the main islands of the empire. Exclusive of colonies, there are in Japan approximately thirteen route miles of railway for every 100,000 inhabitants and a little more than five miles of railway to every 100 square miles of area. This mileage has been accomplished within a period of about fifty-three years.

The traffic on the empire has grown enormously, requiring the operation of a number of light trains running with short headway, and it would be difficult to meet the demand for additional service with present facilities because of the limitations fixed by the narrow, 42-inch gauge. Service is further handicapped by severe grades, many bridges and tunnels, and it has been realized for some time that measures must necessarily be adopted to meet the requirements of increased service.

The change to a broader track gauge or the construction of additional trackage as a means of meeting the demand for more service could be accomplished only at a prohibitive cost. Electrification offered a reasonable method of providing for increased service and future expansion. By electrifying, heavier trains may be operated at higher speeds than are now feasible with steam operation, thus permitting greater headways and relieving the congestion because of the present frequent operation of light trains. Further, much of the passenger operation can be efficiently handled with multiple unit operation of motor cars (and trailers), reserving the freight and long through passenger runs for the locomotives.

Electrification of a portion of the more congested routes has been in effect for several years. The Yamate Line, which forms a belt line around the suburbs of Tokio and serves as an outer connection for most of the main lines radiating from Tokio, was electrified in 1910 and uses a line potential of 600 volts. In 1915, two additional tracks were laid and electrified to parallel the double track between Tokio and Yokohama in order to handle the local service between these two cities. In view of the contemplated extension of this electrification, a line potential of 1,200 volts direct current was adopted. Motor cars and trailers perform the service on these lines, the Yokohama cars running over a portion of the Yamate line, thereby requiring an arrangement of control to provide full speed operation on both 600 and 1,200 volts. The Yamate line will, however, eventually be changed to 1,200 volts.

Two 60.5-ton Baldwin-Westinghouse Locomotive operating on the Imperial Japanese Government Railways

A comprehensive study of the electrification scheme resulted in the decision to use 1,500 volts, direct current, for the trunk line electrification. This system has been used for motor car service, is conveniently adaptable to automatic substation switching, is permissible for third-rail operation (in tunnels) and permits efficient design for large railway motors suitable for the narrow gauge. Further, the adoption of 1,500 volts does not introduce apparatus of an entirely new classification from the present electrifications.

It is logical that the first step in the general plan of electrification should be where traffic is heaviest, hence the extension of the Tokio-Yokohama electric service to Kozu (fifty miles) is in progress. Eventually, the electric service will be extended westward on the main Takaido line to Kobe. In connection with this main line electrification, forty-two electric locomotives have already been purchased and orders placed for fourteen additional locomotives. This main Takaido line extends from Tokio through Yokohama, Numazu, Nagoya and Osaka to Kobe, thereby serving several large and important cities. The line is 374 miles in length and is double-track throughout, with four tracks between Tokio and Yokohama.

After the electrification of the Takaido to Numazu section, the next step in the general electrification program will probably be the electrification of a section of the Chuo line, which is seventy-six miles long and extends from Iidamachi, near the Tokio station, to Kofu.

The service on the double track line between Tokio and Kobe is heavy. There are operated daily, fourteen through passenger trains, half of them running on express schedules. There are also various local passenger trains operated over different sections, and a daily freight movement of three fast freight trains, seven through freights and various local freight trains. The gross tonnage for through freight trains probably never exceeds 650, and the average speed of freight trains is approximately ten miles an hour. The fastest schedule made by the through express trains is approximately thirty-two miles an hour.

Present passenger service is performed by a number of modern, superheater American Pacific type steam locomotives as well as the superheater 4-6-0 type. Freight service is performed by Mallet locomotives for severe grade work as well as the 0-10-0 and consolidation types for heavy freight duty.

Considering the condensed profile of the Takaido line, it is seen that, although the profile is of a rolling nature, the maximum grades of 2.5 per cent. occur in two adjoining sections between

* "Westinghouse International."

(Continued on page 583.)

The Nippon Hydro-Electric Power Stations

*By G. Scott**

THE writer was invited by the Nippon Denryoku Company, Limited, of Osaka, to make a visit to their hydraulic generating stations to see the present and projected developments for power production.

The government railways run from end to end of Japan, for the most part at the foot of hills, running almost the full length of the islands, but there are no railways across country so that such a trip takes the traveler into places not usually visited.

Leaving Kobe about 6 p.m. we travel to Gifu, the starting point for the cross-country route, arriving about 10.30 p.m. Gifu is a small town in the hills not much frequented by foreigners and has no European hotels or food. The Nippon Denryoku Co., provided a stock of tinned foods which helped to vary the *menu* of the Japanese hotels, and the value of which was more appreciated by the writer than it is likely to be by the reader. Continuous meals of native food is *some* problem to a western digestive system and palate.

Gifu has a very curious fishing industry, carried on at night time by torch light. A special bird called "kamo" is trained to dive into the water and catch the fish which it brings to the boat and surrenders to the fishermen.

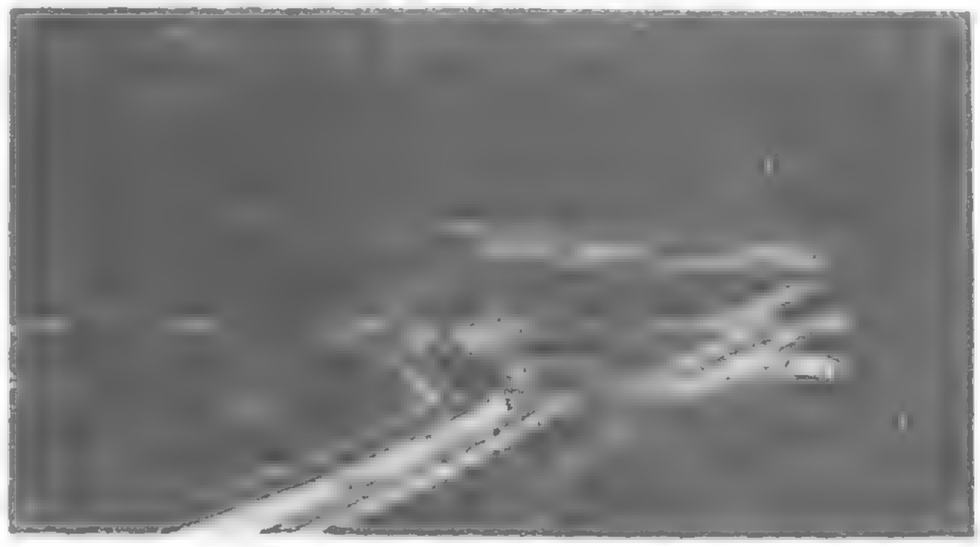


Fig. 1. Sand Settling Tanks

Fig 2.—Penstock, Pipe Line and Station

In a Japanese hotel it is usual to sleep on a "Futon" or downy mattress placed on the floor, and in the hot season under a mosquito net. There is no hardship about this as the bed is very comfortable, but the maximum annoyance can be caused by one little mosquito which lays in wait for you and as you raise the corner of the net to retire enters with you; he promptly begins to hum triumphantly and there is no peace till you lay him low.

We left Gifu at 6.30 a.m. by motor-car and arrived at our first halting place—Seto—about 1 p.m. Seto power station is on the River Masuda. This is the first station of the company to go into commercial service. Water is taken from the river about six miles further upstream. After traversing a short open canal, the water passes through sand-settling chambers (Fig. 1) and thence journeys through a tunnel, 15-ft. diameter, passing through four hills and finally reaches the penstock (see Fig. 2) and is passed through the turbine and discharged to the river.

In order to facilitate transport of materials to site an aerial ropeway 21 miles long was constructed. The transformers and switchgear for stepping up voltage from 11,000 to 154,000, and transmission tower, are shown in Fig. 3. Transformers are General Electric Co., and switchgear, American Westinghouse manufacture.

*Metropolitan-Vicker's Club News.

Fig. 3.—Transformers and Switchgear

Fig. 6.—Power Station Under Construction

The Seto station has a capacity of 30,000 kw., the water head is 330-ft. and the water supply in dry season will carry half this load. On the same river will be constructed two other power houses.

Leaving Seto next morning, we pass the intake and sand-settling chambers and travel through mountainous country along the river until the highest point is reached, and the rivers flow in the other direction, *i.e.*, rivers so far flow to the Pacific ocean, hereafter they flow to the Japan Sea.

This days' journey finished at about 7 p.m. at Furakawa where motor-car was dismissed. The next stage of about 35 miles could not be taken by motor-car as the roads are not suitable, and we have recourse to the jinrickshaw, but with the added power of one dog. Try and picture the conditions, temperature in daytime about 95° F.! The start on account of length of journey and the mountainous nature of it is made at 6 a.m. The dog is called by a whistle, and trots into his harness without any fuss ; there is abundance of water from small streams down the hill sides and the "kuruma" or runner allows the dog to indulge in the luxury of a bath at very frequent intervals. This he revels in and very visibly enjoys, he quietly trots back into harness when called.

When properly under way the endurance of these men and dogs is amazing, they jog along mile after mile in the scorching heat, their feet shod with a kind of grassy sole roped round the ankle and across the foot. Thus for hours they pad along at a trot all the time ; they take meals about every three hours ; the dogs on easy down hill stretches, run ahead and find a cool pond to lie in. The course was along the Takahara river which ran hundreds of feet below us. The beauty of the scenery and freshness of the air, the fresh green appearance of newly-planted rice, and the murmuring of the river cannot be described by words or picture.

The route is through the very heart of the hills, high up on a ledge above the river, the well wooded hill tops are high above the road, the sun is higher up still, and the blue sky finishes a variety of scenes that cannot be portrayed. We arrive at Kanidera about 2 p.m., thus completing eight hours in this intense heat.

The power station here is under construction, and, as will be seen from the Fig. 6, is being tucked into a narrow space between the river and the hill side to the right ; this hill is very precipitous. Two units are being installed, 25,000 kw., the station capacity will be 50,000 kw., waterhead 440-ft. The foundations are solid rock ; the blasting operations reverberate through the mountains with echoes like heavy artillery. Special roads are being constructed to handle the heavy machinery arranged so that an easy angle of inclination can be obtained on the face of this very steep mountain. Smaller parts of about 500-lbs. weight are brought by aerial ropeway from Sasazu, which place they reach by rail from Pacific ocean port. The nearest railway is at Sasazu, about eight miles from Kanidera, and the road along these eight miles is alive with oxen or horse-drawn wagons, all bearing their burden to Kanidera. Three more stations will eventually be built on this river.

The company have a large substation at Sasazu, which is a collecting and distributing station for the locality as they have important holdings in other companies in this area.

We finish the day's journey at Toyama about 8.30 p.m., the last stretch from Sasazu by auto. Next day our journey commences with a short train ride to Mikkaichi and thence by a small electric tramway. As we are now at the edge of inhabited country and the base of the alps, we get an idea of the difficulties which this company has surmounted to obtain water power.

The electric railway just mentioned had to be built before any transport could be undertaken ; it is already 10 miles long and terminates temporarily at Unazuki, where also for preliminary purposes a power station of 1,600 kw. capacity, 530-ft. head has been built. The local bridge higher up the stream has been replaced by the steel bridge, to carry a railway across for the construction of the first station located about two miles further up stream. The water is largely from melted snow and the current runs at 15 miles per hour. There will be three stations on this river, aggregating 60,000 kw.

Observations, survey, etc., have been going on for 10 years past and records made of all the rivers mentioned herein. The Nagasaki steam plant, contains two 25,000 kw. Metrovick turbo sets. The company have shown great enterprise and very considerable skill in location, organization, arrangement, and construction, and will be one of the most important supply companies of Japan.

All are to be congratulated from president downwards on having overcome so many difficulties, the transmission line from towers placed on hill tops miles away from the every-day track, the civil engineering, driving tunnels through mountains, etc., the financing of the whole business, all call for men of great capacity and enterprise, and we wish them all the utmost success.

Electrification of the Imperial Government Railways of Japan

(Continued from page 581.)

Yamakita and Numazu (near Mt. Fuji), totalling a distance of approximately 15.5 miles. These maximum grades will eventually be eliminated by means of a new route and a six mile tunnel now under construction by way of Odawara. Grades of one per cent. occur frequently on this line so that it seems advisable to select a road locomotive of such capacity that the train can be handled on the one per cent. grades without a helper, and for the initial operation, the same train to be handled on the heavy grades with a helper locomotive of the same class as the locomotive.

The Chuo line has several maximum 2.5 per cent. grades with curves of six degrees. One section, 20.6 miles in length, has an equivalent grade of 1.39 per cent.

It is for the purpose of meeting the service and conditions on these two lines that the locomotives recently ordered from the Westinghouse Company, and those ordered in 1922, will be used. Their design has been worked out to provide very favorable standardization of locomotives to meet all the local passenger and express passenger demands, and with some modification, the freight requirements of the imperial government railways. For the freight service, a lower speed gear reduction will be used and the guiding trucks omitted. The control will be modified only by the addition of regeneration equipment.

All locomotives will employ the simple, direct-geared, axle-hung arrangement of motors of the usual railway type. Capacity and speed variation for the different classes of passenger service will be obtained by variation in the number of motors and gear ratio. A very marked degree of standardization has been obtained in the design of the locomotives, in that the same motor is used in all three types as well as the same size wheels, unit switches and other individual pieces of control and brake equipment.

All locomotives will have a single box type cab, and for the passenger locomotives, articulated trucks will be used with frames of cast steel. The cabs will have two operating compartments, one at each end, and an equipment compartment in the centre. On the new locomotives flexible spur gears of the coil spring type will be used. Westinghouse air brake equipment combined with a vacuum brake system will be supplied as well as two hand brakes. Left hand drive, according to imperial government railway standards, will be arranged. Coupling of the standard MCB automatic type will be provided as the imperial government railway is changing over from the continental type which has been standard.

The main motors are known as the type 352, which have a nominal rating of 300 h.p. and are suitable for operation, two in a series, on 1,500 volts. This motor was specially designed and built for the imperial government railways electrification and embodies the characteristics necessary for the service and track gauge. It is arranged for field control and forced ventilation.

The control is of the double end, Westinghouse type H.B.F., embodying a 32-volt battery supply for operating the electro-pneumatic switches which are employed for all main circuit switching. Air operated pantagraphs of special design are employed.

Six of the locomotives will be of the 2–4–0+0–4–2 type. The approximate total weight will be 153,100 pounds with 114,000 pounds on the drivers. The motors will be the same as those supplied on the experimental locomotives, giving a total nominal rating on 1,500 volts of 1,200 h.p. a cab.

Two of the locomotives will be of the 2–6–0+0–6–2 type. They will employ the same type motor and gear ratio as the 2–4–0+0–4–2 type. The two types will be as similar as it is possible to make two such locomotives of different wheel arrangement. These locomotives have a nominal rating of 1,800 h.p. and are intended for use in high speed express passenger service on the Takaido line. They will be capable of handling a 460 ton train under the average conditions for this class of main line service. The speed with this weight of train will be approximately fifty-three miles an hour on straight level track.

Plengan Hydro-Electric Power Plant on the Saroewa River (Preanger), Java

Hydro-Electric Development in N.E.I.

SINCE 1910 the water-power problem for the N. E. I. has had the attention of the government, in the beginning only with a view to the future electrification of the state railways, later on, in a broader sense, in interest of a better supply of energy as a chief factor for the industrial development.

The service for water-power and electricity, which was created in August, 1917, is an independent section of the department of government services. This new section has been given the task to promote a supply of economical energy for the territories, which are in want of it, to make a proper use of the country's water-power and to give every assistance, not only in the interest of the industrial development of these districts in general, but also for the benefit of the state railways and other government services.

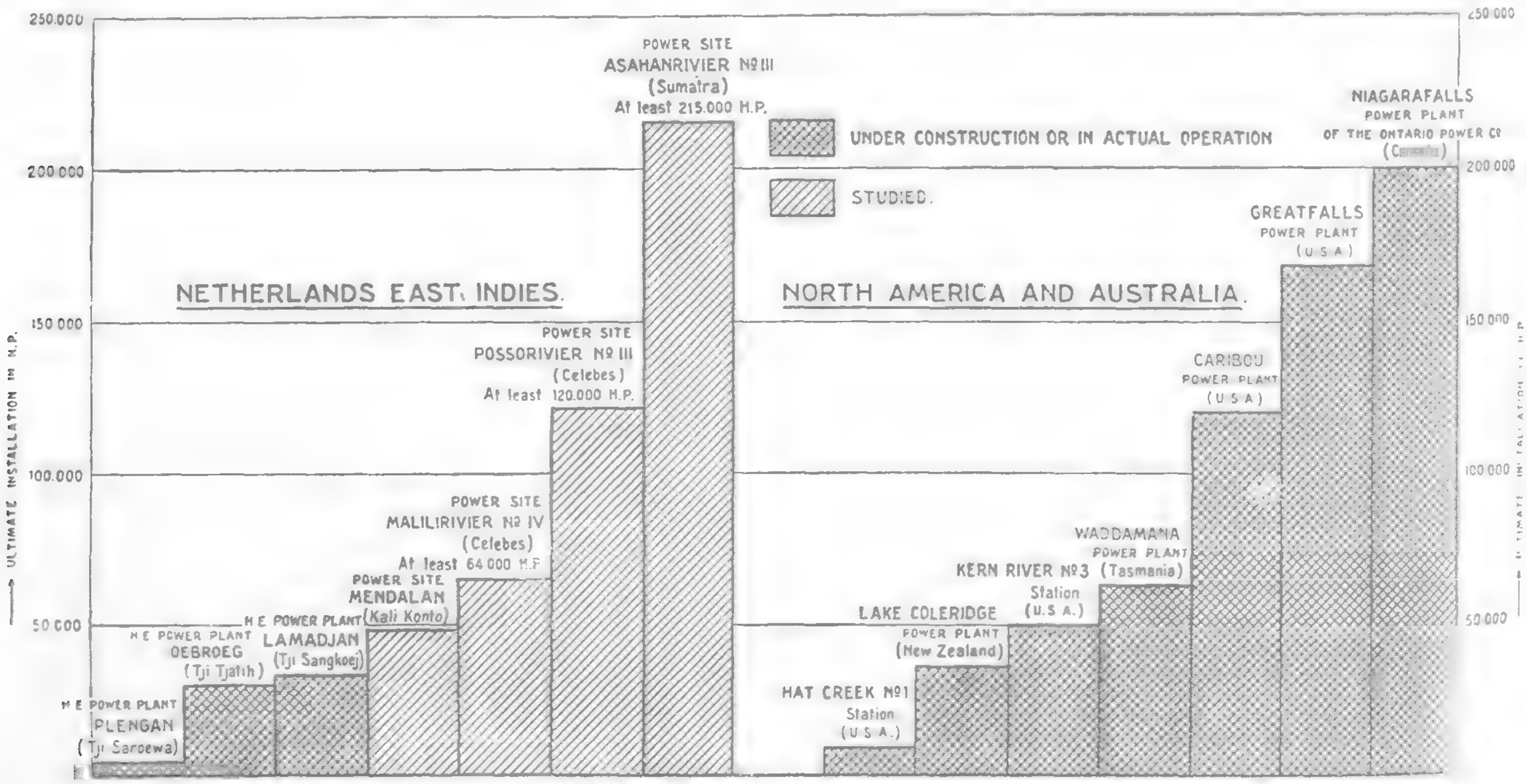
To fulfil this task the following measures were taken :—

1. The building of state water-power works, not only for industries and services already existing, but also for supply of electrical power in general.

2. State exploitation of power stations and participation of the state in other electrical industries for the distribution of the energy.

3. The establishment of a water-power cadastre to give expert advice to interested parties regarding water-surveys, water-power wells and concessions.

4. Revision of the water-power and electricity regulation.



Capacity of Some Water Power Plants and Sites in the N.E.I. compared with Plants in America and Australia

TYPICAL HYDRO-ELECTRIC INDUSTRIAL POWER PLANT IN THE N.E.I.

The Power Plant of the Netherlandshe-Indische Portland Cement Works at Padang, Sumatra

Inlet Gate on the Loeboek, Kitangan River

Sluice Gate at Inlet

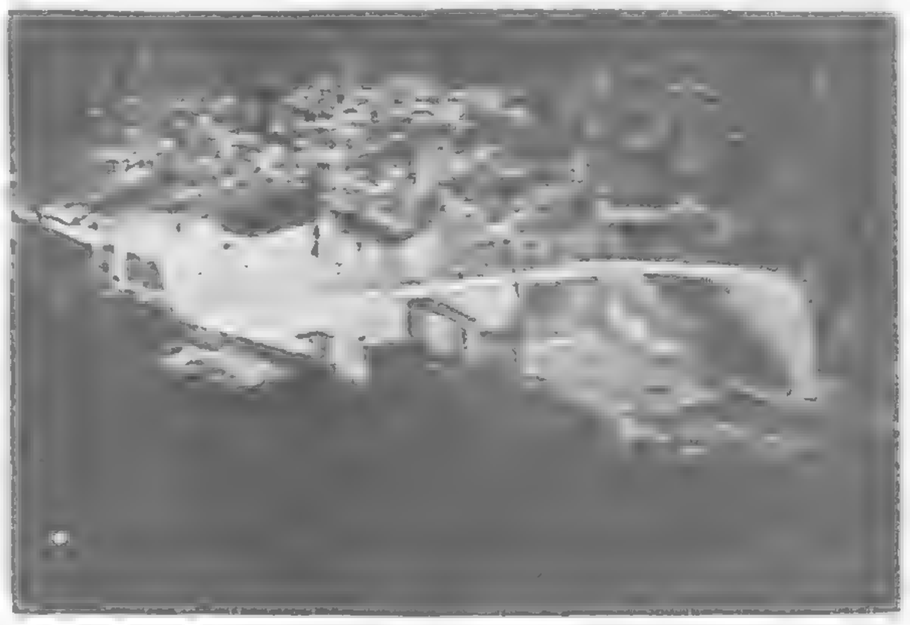
To divide the above-mentioned task in a practical way, the service possesses, besides an administrative, three technical sections, viz., the hydro-technical, electro-technical and the building section, which are all established at Bandung. *The hydro-technical section* includes the following operations:

(a) *Research for and the making of an inventory of water-power.* On the whole the natural conditions for the exploitation of water-power in the N. E. I., may be considered favorable; as especially favorable factors should be mentioned: the large annual rainfall, the appearance of large lakes, suitable for accumulation—especially in the outer districts—large falls owing to the mountainous nature of most of the islands and the absence of a winter season with, as a consequence, the elimination of the drawbacks of snow and ice.

Flume-to-Turbine

On the other hand the unfavorable circumstances are the prevalance of a characteristic dry season (east monsoon), the rarity of good solid rock bottom and, as a consequence of this, the mostly necessary long survey for the pipelines.

The Canal



Canal End and Entrance to Flume

According to a rough estimate, whereby, for a large part, the still unknown, but probably in water-power very rich New Guinea is not included, in the N.E.I. 5½ million h.p. are exploitable for works of more than 1,000 h.p. This capacity is divided as follows over the various islands:

	H.P.
Java ..	500,000
Sumatra ..	2,000,000
Celebes ..	1,000,000
Borneo ..	2,000,000
Total ..	5,500,000

800 h.p. Francis Spiral Turbine, 750 r.p.m. made by Amme, Giesecke and Konegen of Brunswick, driving a Siemens-Schuckert Generator (3,000 volts)

Survey of water-powers exploited and exploitable at the end of 1922 :

JAVA

		Tower in H.P. Minimum in dry season	Average in 9 months
Surveyed but probably not exploitable		240,000	410,000
Not further surveyed, economically exploitable powers of more than 500 h.p. average capacity		400,000	690,000
Examined by the government of which	completely surveyed, planned and estimated	83,300	153,500
	under construction	9,900	22,100
	constructed and working ...	3,700	7,150
Granted the concession of which	construction not yet started ...	4,880	9,950
	under construction	3,720	6,580
	constructed and working ...	3,910	5,420
Used according to permits until further notice		10,000	13,700

OUTER DISTRICTS.

		Power in H.P. Minimum in dry season	Average in 9 months
Surveyed but probably not economically exploitable ...		—	—
Not further surveyed, economically exploitable powers of more than 1,000 h.p. average capacity		1,858,000	2,852,000
Examined by the government of which	completely surveyed, planned and estimated	530,000	727,000
	under construction	—	—
	constructed and working ...	2,000	2,000
Granted the concession of which	construction not yet started ...	219,000	316,000
	under construction	—	—
	constructed and working ...	3,800	5,450
Used according to permits until further notice		6,500	6,500

The energy exploited by the government is divided over the following power stations (at the end of 1922) :—

Name of the power-station	Purpose	Installed Energy in h.p.	9 monthly power of the works in h.p.
Java			
1. Tji Geureuh I	Supply of current to...	200	200
2. „ „ II	the Radio Station Malabar	350	350
3. Plengan		4,500	2,300
4. Bengkok	Energy supply of Bandung and vicinity and Malabar Radiostation	4,500	3,000
5. Giringan	Energy supply to railway workshops and illumination of Madiun ...	2,000	2,000
	Total *Java* ...		7,850
Sumatra			
1. Teis	Energy supply to state and private gold-mines	2,000	2,000
	Total *Java* and *Sumatra* ...		9,850

At the end of 1922 the following power-stations were under construction :—

Name of the power-station	Purpose	Energy to be Installed in h.p.	9 monthly Energy of the Works in h.p.
Java			
1. Kratjak	Electrification in and around Batavia	24,000	8,000
2. Ubrug	general energy supply for various places	21,500	7,500
3. Dago	Energy supply in Bandung and surroundings and Malabar radio station	1,000	900
4. Lamadjan		27,000	10,000
	Total *Java* ...		26,400

Of all the powers mentioned above—those already in use as well as those not yet used or given in concession—the principal details as to situation, capacity (drop and output), existing topographical surveys, accumulation possibilities, etc., are systematically registered in the *water-power cadastre*.

This water-power cadastre is accessible to the public ; private individuals who wish to use water-power, can get information free of charge as to what is known already about the appearance of the power energy in rivers, or irrigation-canals suitable for their purposes. If necessary the available hydrographical and topographical data can be supplied against a small remuneration.

(b) Water Surveys.

At the end of 1922 there were in all 72 water-survey stations. These are spread as follows over the various districts :

1. In Java 55, of which 29 are provided with self-registering instruments :
2. In Sumatra 10, of which 3 have self-registering instruments;
3. In Celebes 7, of which 4 are fitted out with self-registering instruments.

By regular daily gauges of the waterlevel and periodical gauges of the discharge by means of hydrometrical mills and by a chemical system (in 1922 311 gauges were made in all), the daily output is fixed at these stations. The results of these gauges are published yearly in bookform.

(c) Preliminary Plans and Estimates of Cost.

For the water-power works to be built by the government for the general electrical supply and for certain government enterprises, the necessary detailed plans, estimates and calculations of productiveness are made. At the end of 1922 of such plans were in hand :

The supply of energy for Sourabaya by means of water-power from the river Konto (capacity : 11,500 h.p. constant power) and the extension of the supply of energy by the Bandung highland, by increasing the existing reservoirs and power-stations of the Tji Sangkoej.

Similar preliminary plans are, if needed, also worked out for provinces or Boroughs, and in special cases even for private concerns.

(d) Handling of Applications for Water-power Concessions.

All applications for the granting of water-rights are examined, and a report submitted to the bodies who must grant these rights.

In the N. E. Indies there are two kinds of permits for the use of water-power.

(a) permits until further notice for power below 100 theoretical h.p., exclusively for own use, and

(b) permits for a duration of 40 years for power of more than 100 h.p. theoretical power, intended also for supply of energy to others. The first mentioned permits are exempted from payment; for the latter permits (concessions) a yearly water-tax is charged amounting to :

glds. 2.—per theoretical h.p. for the first 900 h.p. above 100;
„ 1.50 „ „ „ „ „ following 9,000 h.p. ;
„ 1.— „ „ „ „ „ power above 10,000 h.p.

Applicants for permits, if they desire so, are supplied with all available details regarding the appearance of suitable sources of energy and information of the construction.

Typical Estate Factory near Medan, Sumatra, East Coast, operated by Electricity produced by Water-power

The quantity of economically exploitable power known is mentioned before. The size of these various sources of energy to

be used in a single work, compared to those of foreign works, may be seen from the diagram, printed on page 601.

The electro-technical section has the task of studying and working out plans for the mechanical and electrical installations of new steam and water-power works and to extend existing power-stations, which are under the department of government services.

Furthermore this section gives advice to other government institutions, and especially to local resorts, regarding matters belonging to their sphere of activity.

It exercises, according to the principles accepted by the government, the "electricity politics," which must lead to an electricity supply as rational as possible of the territory of the N.E.I. In connection with this, it deals with all applications received for the construction of local electric works, and supervises the execution of the permits granted.

Electrical problems of general interest are studied up, among which must be mentioned the making up of regulations, the promotion of normalization, and the collection and working out of statistical details.

At the beginning of 1923 the total of the generator power of 105,200 k.w. installed in the N.E.I. was divided as follows:

	Water-power	Caloric Centrals	Total
Public electrical works ..	2,400 k.w.	22,800 k.w.	25,200 k.w.
Government enterprises ..	8,600 ,,	17,200 ,,	25,800 ,,
Private industries ..	8,400 ,,	45,800 ,,	54,200 ,,
Total	19,400 k.w.	85,800 k.w.	105,200 k.w.

In all there are in the N.E.I. 20 cities in possession of public electric works.

Electric Cars for the Java State Railways

In its program of railway electrification the Java State Railways is equipping with modern motor cars and trailers for suburban passenger service, a section that includes the cities of Batavia and Meester Cornelis.

The cars themselves are being built and the wiring conduit and some of the lighter parts of the electrical equipment put in, by the Royal Car Works of Haarlem, Holland—Koninklijke Fabriek Van Rijtuigen en Spoorwagens, a concern that has been in the business of making railroad cars since 1838 and is still owned and managed by descendants of its founder, Mr. J. J. Beijnes.

There are thirty cars on order, half of them motor cars and half of them trailers. Five will be driven by Westinghouse motors and ten by motors of the General Electric Company. The trolley voltage is 1,500 d-c. and each motor car will carry a motor-generator set to supply 65-volt current for operating the control mechanism and air compressors, supplying the lights and charging the storage batteries. In tropical Java, no less than in the subways of New York, fan motors are essential and the so-called subway type of ceiling fan will be used in motor cars and trailers. Electro pneumatic control is provided for opening and closing the doors.

An interesting thing about these cars is the large number of countries from which their essential parts have been gathered. Their all-steel bodies, built in Holland, have roofs of teak wood, brought from India and covered by rubberoid made in the United States. The floor material comes from France, window glass from Belgium, and mahogany for the interior trim from Cuba. Switzerland supplies wiring devices and Canada asbestos linings. Truck springs are furnished by the Krupps, Germany, while the Westinghouse air brake equipment comes from England. Belgium furnishes wheels and axles and the couplers which are the American MCB type with an additional device for coupling in emergency to the existing steam trains. The Holland made car bodies have American standard vestibule buffers. The contribution of the United States includes pneumatic door opening mechanism of the Consolidated Car Heating Company, Albany, car seats from the J. G. Brill Company, Philadelphia, rubberoid of the Standard Paint Company, New York, and the entire electrical equipment. The latter comes from the two American companies, previously referred to, and from the Electric Storage Battery Company of Philadelphia, whose exide batteries are employed.

Gathered together and assembled by the Netherlands government, it is permitted to speculate as to whether this international assemblage would be brought before the Hague, the World Court or a similar tribunal, in the event of any failure of the constituent parts to function in friendly co-operation. It is our opinion that there will be no such occasion and that on the contrary the success with which these mechanical representatives of many countries work together for a common purpose is likely to be an object lesson worth pondering by those who guide the destinies of nations.

Prior to the assembly of the electrical equipment on the cars in Java, a sample car was fitted out in Holland, under the direction of engineers of the department for the colonies assisted by Mr. E. E. Carrier, of the General Electric Company, who will supervise the assembly of the remaining cars in Java.

Mr. Carrier, at the time of the shipment of the sample car from Haarlem, wrote as follows: "The care taken by the car builders in the workmanship and finish of these cars cannot be surpassed anywhere in my opinion."

Another General Electric engineer, Mr. J. R. Johnson, is in charge of the erection of a substation at Meester Cornelis. This is a 3,000-k.w. plant and includes two 1,500-kw., 1,500-volt three-unit synchronous motor-generator sets, operating from a three-phase, 6,600-volt power supply that is drawn from a 70,000-volt hydro-electric system.

First Turbine-electric Driven Ocean Liner for the Pacific Trade

MORE than passing interest attaches to the announcement that the Matson Navigation Company of San Francisco has adopted turbine-electric drive for the latest of its passenger carrying ships for service between San Francisco and Honolulu.

For the past ten years ships of other types have been thus equipped but this new boat will be the first in the oversea passenger liner class to make use of turbine-electric propulsion. She will be built by William Cramp and Sons, Ship and Engine Building Company of Philadelphia, and her naval architects are Gibbs Bros., Inc., of New York, who specialize in the design of ocean liners.

She will be a twin-screw ship of 17,500 tons displacement, 24,000 horse-power, 21 knots speed, length 578-ft. and beam 76 ft. There will be accommodation for 600 first-class passengers and a crew of 250.

In choosing turbine-electric drive, ship owners are assured of certain advantages, among which is one of outstanding importance, because of its effect upon the continued maintenance of sailing schedule. It may be expressed in a single word that is full of meaning, *reliability*. It has been shown by the performance of other ships over a period of years that the turbine-electric drive is reliable; it possesses the element of simplicity of mechanism and this implies a long continuous service with but little overhauling.

Instead of direct mechanical connection between the prime mover and the propeller, or connection through gears, the power is transmitted through magnetism and that provides a degree of cushioning that absorbs mechanical shock. This in combination with perfectly balanced high-speed machinery eliminates vibration and makes for smooth and quiet operation, features most desirable in all types of ships but particularly to be desired in a passenger liner.

The comparatively small number of wearing surfaces and the ease with which electrical machinery can be repaired when necessary, are characteristics that aid in the keeping of the equipment in good condition through long periods and in shortening the time that a ship must be out of service for overhauling. This it will be recognized has a direct bearing on the maintenance of schedule and therefore on income derived.

Electric ship propulsion is no longer a novelty and it passed the experimental stage some ten years ago. It required faith, however, to make the first installation, because at the beginning it seemed like a revolutionary thing to depart so radically from the long approved practice of marine engineering and adopt something that had never been given a trial on the sea. A big electric plant might be perfectly satisfactory when anchored to the ground but what would it do when floating and buffeted by winds and waves?

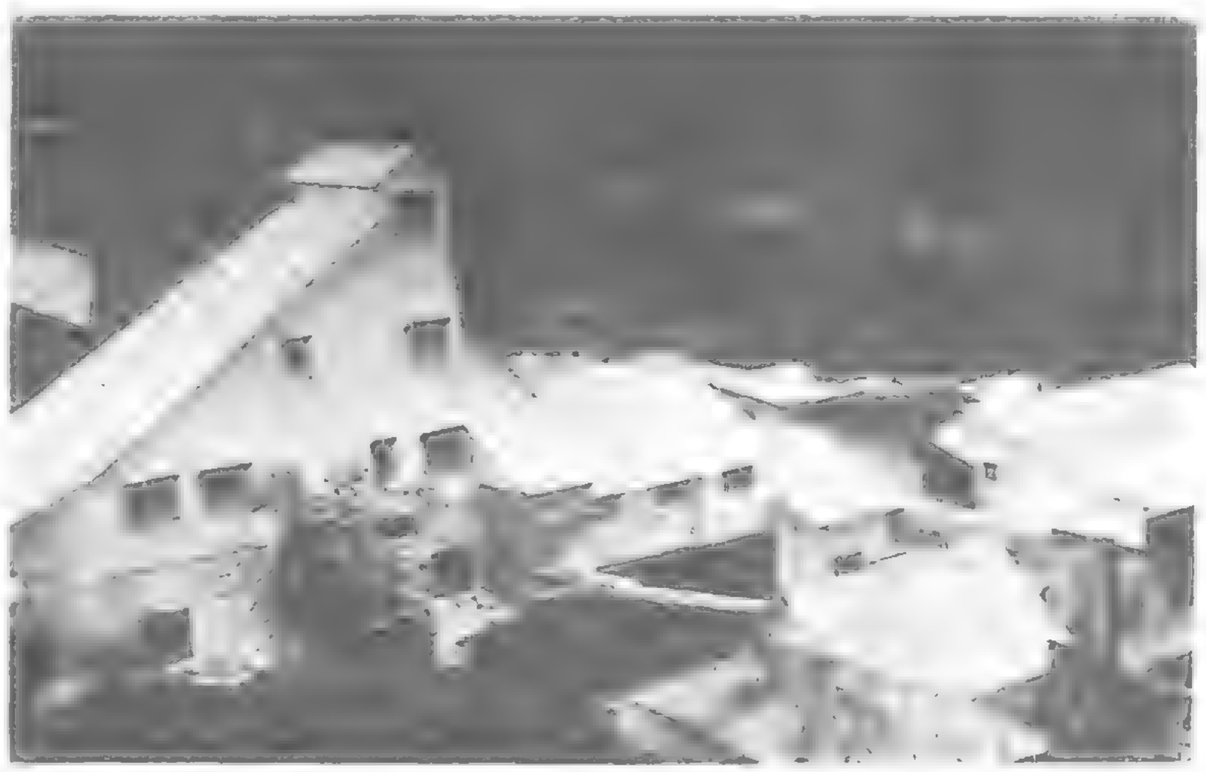
Besides the great and smaller vessels of the navy, electric drive has been applied to ships of the merchant marine and harbor craft, some using turbines and some Diesel engines as prime mover. In the class of trans-oceanic *passenger* liners, however, the Matson line ship is the first to be equipped for turbine-electric propulsion.

Gold Mining in the Philippines

By Dr. Francisco Villanueva Conlu

Gold Mining, an Ancient Industry

MINING for gold was practiced in the Philippine Islands long before the advent of the Spaniards. There is scarcely a province in the archipelago in which gold has not been obtained by the natives, who are skilful pan miners and clever in dealing with accessible quartz. Chinese writings of about the third century, A.D., report gold as the chief product of Luzon, one of the most important and largest islands of the Philippines. Before Magellan's arrival the Filipinos carried commerce with China, and they paid for silks and other Chinese manufactures in gold and other Philippine products. Alluvial deposits accessible to the Chinese and Malay traders, who had intercourse with the islands long before they were known to Europeans, have been to a great extent worked over and over again. The natives used as tools a washing board and a wooden bowl. Bowlders and fragments of quartz with visible gold occur in many alluvial deposits in the islands. The ancient process was by pulverizing the quartz by hand and washing it like they wash the auriferous gravel and sand. When the Spaniards came they introduced an improvement on this rude process, consisting of the so-called "Mexican arrastra," a block of rock moved by buffalo power like a millstone on another block. The charge of an "arrastra" is about 250 pounds. After the American occupation of the islands, much activity in prospecting and development work was shown in several districts by American miners, and modern mining machinery was imported to the country from the United States and up-to-date methods employed in working the claims.



Centre of the Antamok mining district, where most gold claims of the Benguet subprovince are located

Gold Mines Discovered

Gold is the first in importance of the metallic mineral resources of the Philippines. According to the census of the Philippine Islands taken under the direction of the Philippine legislature in the year 1918, gold has been found in the following provinces: Agusan, Benguet, Bukidnon, Bulacan, Camarines Norte, Cebu, Iloilo, Lepanto, Mindoro, Misamis, Nueva Ecija, Nueva Vizcaya, Pangasinan, Romblon, Sorsogon, Surigao, Tayabas and Zamboanga.

In most cases the gold that is found is detrital, and is found either in existing water courses or in stream deposits now deserted by the current. These last were called "aluviones" by the Spaniards. Of all the auriferous provinces, Benguet, Masbate and Ambos Camarines are rivales for first place in the metal output and in general mining activity.

The gold ores in the Benguet region are partially free milling, but for the most part refractory. The gravels of the river Agno carry gold. A further description of the Antamok mining district in Benguet will be made in a later paragraph. In the provinces of Bontoc and Benguet the deposits are in all respects analagous to those of Lepanto. Gold has been mined for centuries both from vein and placers. Since American occupation the mountain range has been prospected by Americans, and several hundred claims have been located.

In Camarines Norte, the townships of Mambulao, Paracale and Labo, are especially well-known as gold-producing localities. Here quartz veins are found, carrying besides gold, iron pyrite, copper pyrite, galena, and zinc blonde, sometimes also accompanied by lead chromate. At Paracale there are parallel quartz veins in granite, one of which is said to be 20-ft. in width and contains a chute in which the ore is reported to assay 38 ounces of gold to the ton.

In the province of Abra, at the northern end of Luzon, there are placers, and the gravel of the river Abra is auriferous. There gold is found in alluvial deposits, and in the sands of the river of the same name, as grains, and has an average fineness of 0.750 to 0.792.

In the province of Lepanto gold occurs in three different ways in veins, in alluvial deposits and in river sands. Its fineness is

Two American miners doing work in the power plant of the Benguet Consolidated Mining Company

Power plant of the big American mining corporation, The Benguet Consolidated Company

from 0.792 to 0.833 and it is somewhat light colored because of a considerable silver content. It is usually accompanied by ores of silver, copper, iron and lead. Gold is obtained in this province close to the copper mines.

In the province of Nueva Ecija the gold is exceedingly pure, brilliant in color and 0.958 fine. It is found as rounded particles in alluvium and sometimes in small crystals.

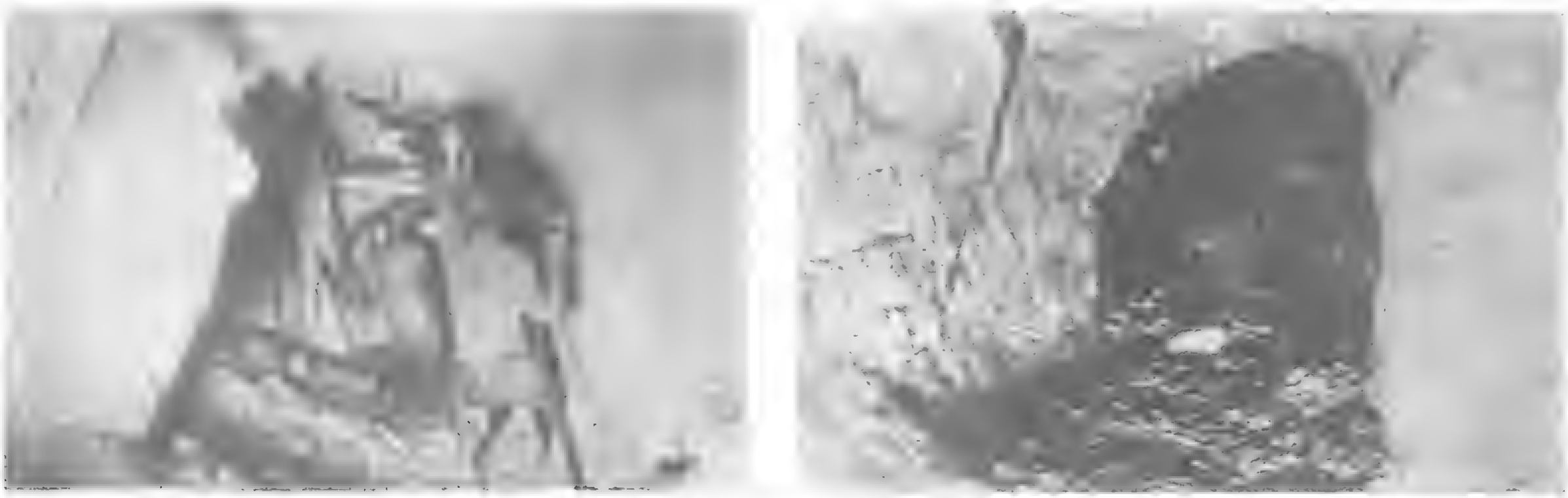
In Mindanao some of the gravels are in an elevated position and adapted to hydraulic mining. In this island there are two known gold-bearing districts. One of these is in the province of Surigao, where placer and other townships show gravels and veins. The second district is in the province of Misamis. Near the settlement of Iponan, on the Gulf of Macajalar, there are said to be many square kilometres of gravels carrying large quantities of gold, with which is associated platinum.

The Mines of Antamok, Benguet

Antamok, a region down the sub-province of Benguet, is the best Philippine gold mining district. It lies on a direct line south of Tubia some ten miles. Here geological conditions change somewhat and the vein and ledges become much stronger. On certain claims in this district a distinct contact of diorite with syenite occurs, but the ledges are lying on granite porphyry, which lies between the quartz and the syenite. The ledges are large, having a mean thickness of 12-ft. However, there are segregated stringers of extremely rich gold ores running out into the serpentine porphyry which have been unquestionably, by reason of secondary fissuring and ore deposition, extracted by agencies of water and hot gasses, from the main ledges and the porphyries, which are always great feeders to veins. The syenite occurs on the west side or the footside of the contact, while the hanging wall side is composed of quartzose diorite. There are also many veins in the diorite due to subsequent fissuring after the cooling of the quartzose diorite and occur in most all instances with porphyry and serpentine extruded through the later fractures or fissuring. These saprolitic veins or veinlets carry gold and some of them are extremely rich. This camp is only 6 miles northeast of Baguio, the capital of Benguet, and with plenty of water at hand for all power needed to operate machinery.

Exploration of Mining Claims

Upon the passage of the Philippine act, the act of the United States Congress of July 1, 1902, the mineral deposits in public lands in the Philippine Islands were declared to be free and open to exploration, occupation and purchase, and the land in which they are found to occupation and purchase, by citizens of the United States or of the Philippine Islands, and in pursuance thereof an enactment was passed by the Philippine commission prescribing regulations governing the location and manner of recording mining claims, and the amount of work necessary to hold possession of a mining claim. The administrative work with reference to titles to mining claims is in the hands of the Bureau of Public Lands, and the Bureau of Science has charge of the work of effectively carrying out reconnoissances of the important mineral regions of the Philippines in order that accurate information of value to the prospector,



Filipino natives drilling

the miner and the capitalists, may be made available, and the development of the mining industry may be stimulated.

American Miners and Mining Companies

Numerous claims have been located in the mining provinces and several companies have been organized to develop and operate a number of the most important groups. The success of some of the companies which have entered the field, to judge from their continuous operation and constant output, may be considered assured. For instance, there stands in the Antamok district, the Benguet Consolidated Mining Company which operates upon an investment of about P.2,000,000 in modern machinery and equipment.

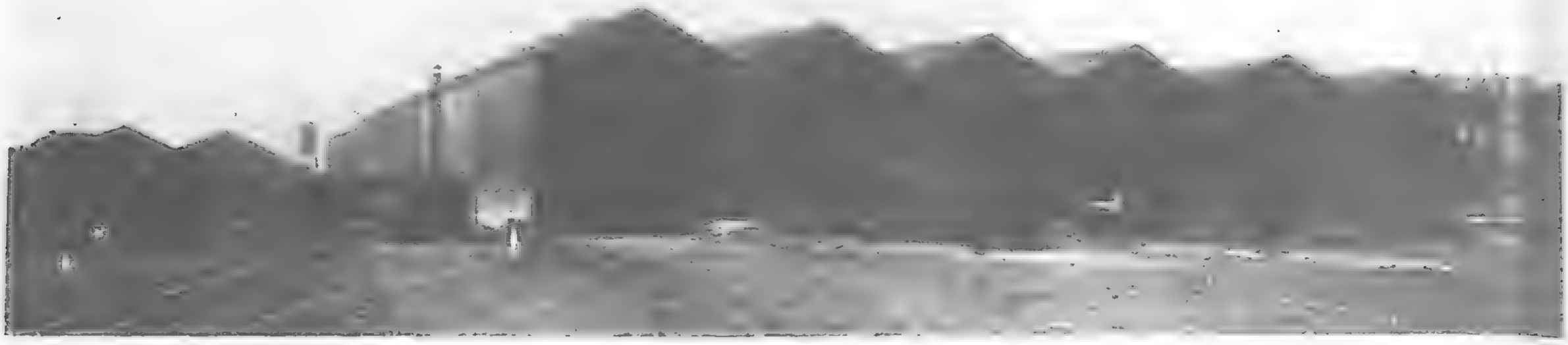
The number of American citizens who are engaged in mining all around the Philippine archipelago amount to about one hundred They are rendering a very valuable service to the mineral industry

Diesel-Electric Tanker for the Pacific

FOLLOWING the satisfactory operation of two Diesel-electric tankers now in its service, the Standard Oil Company of California has ordered a third which, it has been reported, will operate between San Francisco and the Hawaiian Islands. This tanker will be similar in all respects to the two others with one exception; the engine room will be amidships and the propulsion motor, aft. In the previous craft, the engine room was aft.

The new tanker will have an overall length of 221-ft.; length between perpendiculars, 210-ft.; beam, molded, 36-ft.; depth, molded, 16-ft. 6-in.; approximate mean draft, loaded, 13-ft. 6-in. Power will be generated by two 245 kilowatt, Diesel engine-driven generators, normally to operate in series. A 30-kilowatt generator, using the same shaft, will be included in each set for excitation purposes and auxiliary power. Propulsion power will be furnished by one 600-horsepower, 130 r.p.m. motor, driven by the main generators. The auxiliary generators will operate alternately, one acting as a stand-by for the other.

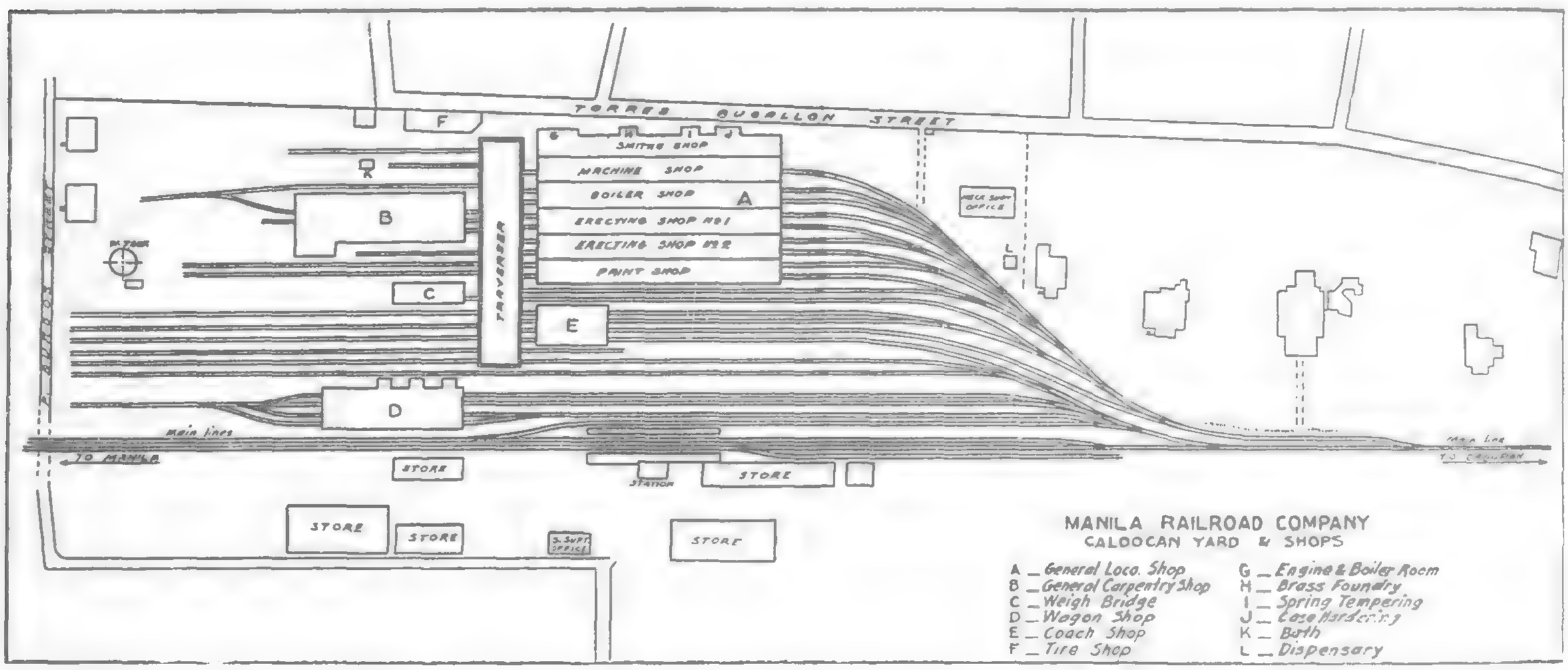
In addition to the propulsion equipment, electric power is used for auxiliaries above and below decks. All the electrical machinery is General Electric manufactured by the General Electric Company of America. Below decks, electric power will drive ventilating and pumping apparatus and a five-kilowatt generator will carry the auxiliary lighting load. The deck auxiliary machinery will include anchor windlass, cargo winch and capstan motor equipments.



Machine and Erecting Shops of the Manila Railway Company at Caloocan

The Caloocan Shops of the Manila Railway

THE Caloocan machine shops of the Manila railway cover an area of 77,040 sq. ft. and have just recently been extended and equipped with modern machinery. The building is of latticed steel columns, sides and roof of corrugated iron. The arrangement of shops is as follows and can be followed by reference to plan herewith :



The large building marked "A" consists of blacksmith's shops, coppersmiths, and machine shop, under one span. Boiler-maker and plating shop adjoining, with four pits the full length of shop, under two other spans. The blacksmith shop houses 12 forges, with 10 tons steam hammer, coppersmith shop has three fires and two tube welding furnaces, with a Thompson electric welder for steel tubes and for superheat flues. Adjoining the coppersmith shop is a case hardening furnace, as also a small brass foundry with a three pot furnace.

The machine shop is 360-ft. long by 45-ft. wide and contains 29 lathes, grinding machines, slotters, planers, drills-radial and stationary, milling machine, large wheel lathes, boring mill, lapping machines, thread cutters. The shafting runs both sides of shop, is mounted on ball-bearing pedestals, and is driven by a 270 h.p. engine supplied with steam from two Lancashire type boilers 30-ft. long by 8-ft. 2½ dia. The boilershop is 360-ft. by 35-ft. wide and is capable of holding 30 boilers, both large and small at one time.

Workmen Checking out at Noon

Machine Shop: Car Wheel Lathe in Foreground

this shop is equipped with a 20-ton traveling crane, 3 forges, a set of rolls, and punching and shearing machine capable of working 1-in. plate.

Portable electric welders are in the boiler and erecting shops, and a fixed two arc is in the building marked "C." Oxy-acetylene cutting torches and welding are portable and can be taken where required.

The two erecting shops are 360-ft. by 35-ft. wide and are fitted with drop pits in each bay capable of lowering and lifting 10 tons: in the first bay there are two 30-ton overhead traveling cranes and in the second bay there are two 50-ton overhead traveling cranes capable of lifting the latest and heaviest locomotives.

The whole of these bays are supplied with compressed air at 100-lbs. the drop pits also being worked by this medium.

The last bay of the six is the paint shop, where also are placed fitters' benches for vacuum brake work and the internal mechanical parts of coaches.

Across the way from machine shop is the coach building and carpenter's shop, 256-ft. long by 71-ft. wide, marked "B" and in this building are housed the tinsmiths and electrical departments. At the far end of the carpenter's shops is the machinery bay for sawing of logs, planing and jointing machines, saws, band and re-saw, morticing machines and universal joiner.

The building marked "C" contains a weighing machine capable of weighing any locomotive the company possesses, each and every wheel being weighed separately and at one time.

Frame of First and Third Class Car on Traverser

The building marked "D" is the old running shed now used as a wagon building shop, whilst "E" is for coach repairs.

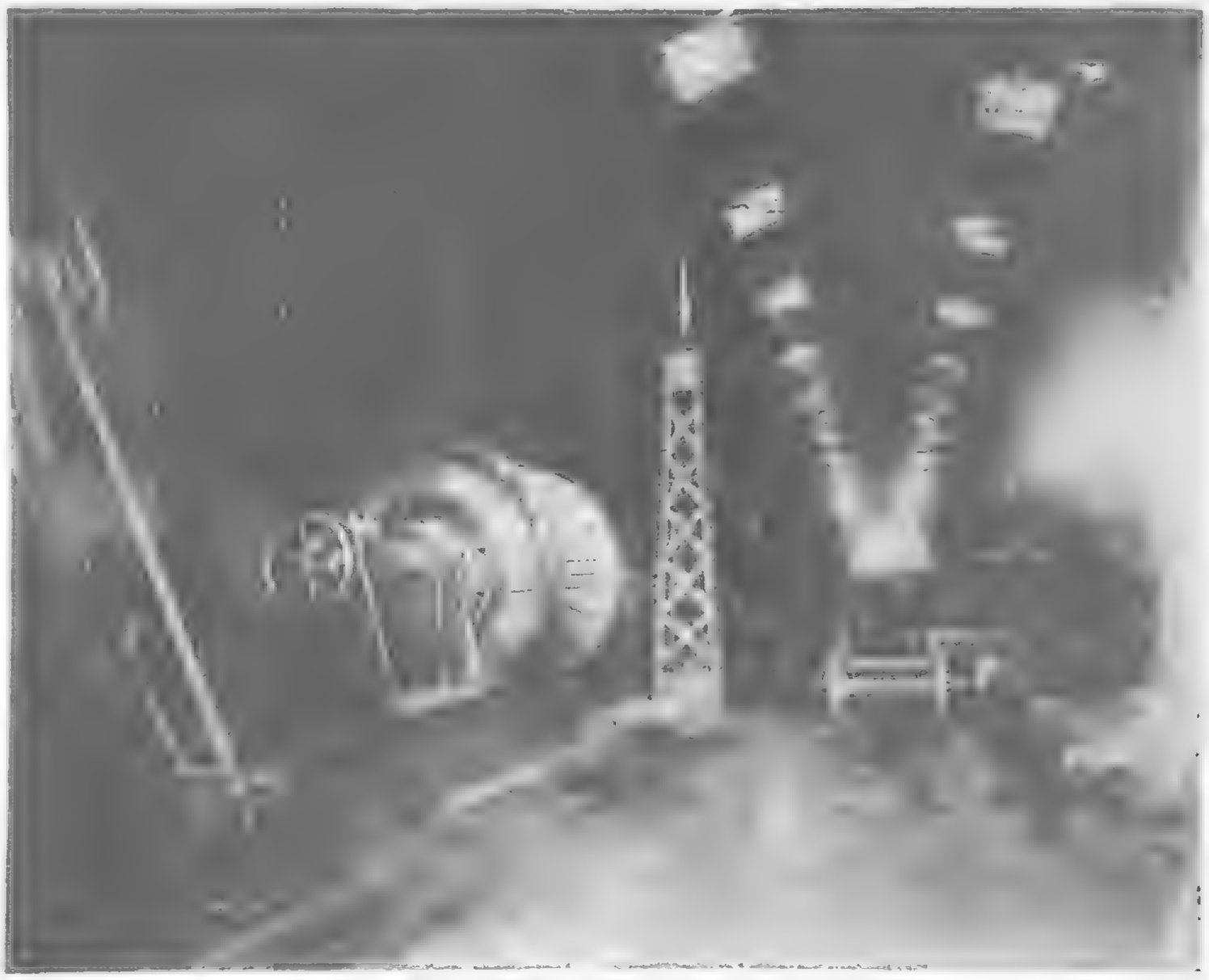
The spaces between "B" and "D" are used for the repair and erection of coach and wagon frames, back track, etc., and are also supplied with compressed air from the main compressor in the machine shop for spray painting, and rivetting.

Communication between the machine and carpenter's shops is supplied by a traverser running the full length of machine and coach repair shops, a distance of 238-ft. long and 60-ft. wide. At the end of this traverser pit, through which it is supplied is the wheel alley marked "F," which contains one 400-ton hydraulic press, one tyre furnace, quenching well, and a small furnace for buffer making. Shower baths for workmen's convenience lie between this alley and carpenter's shops. Water is supplied from two artesian wells, air lift.

The shops are situated at Caloocan on the main line north, 9 kilometres from Manila and were originally built in 1889, to take care of 30 locomotives and 122 miles of road.

As before stated the machine shops is new, being built in 1913, and enlarged 50 per cent. in 1923.

The shops as they are to-day can easily take care of 10 per cent. of motive power with from 6 to 8 per cent. of rolling stock at one time. This company now possesses 152 locomotives ranging from 16 tons to 127 tons. 192 passenger coaches and 1,952 goods and service stock, whilst total mileage is 657.



Machine Shop: Engine Wheel Lathe in Foreground

The Drewry Car Exhibit at Wembley

THE rail car exhibited is Drewry standard 20 h.p. type arranged to seat six persons, and is fitted with a four-cylinder engine of 90 m.m. bore by 130 m.m. stroke, which is similar in design and construction to the engines used in Drewry locomotives. A three-speed gear box and reverse gear giving all three speeds in both directions is fitted. The power is transmitted from the gear box by silent chain to the axle. Controls are fitted at each end of the car and it can, therefore, be driven equally well in either direction, the driver always sitting at the leading end.

The newly forged type wheels fitted are 24-in. diameter. Hand brakes are fitted, arranged to operate on both wheels of the axle which is not driven, and in addition there is a foot brake arranged to operate on the countershaft, thus breaking through the driving axle. Tabular radiators are fitted at each end of the car, and water is circulated by means of a rotary pump driven from the engine.

The car is fitted with well upholstered seats having reversible throw-over backs, enablingpassengers to always face in the direction in which the car is traveling. Windscreens are fitted at both ends of the car. The canopy is supported at each corner by pillars and also by centre stanchions at the sides. Side doors are fitted also side curtains which are rolled up under the roof when not in use and can be made to completely enclose the sides of the car.

If required, electric lighting and self-starter sets can be fitted.

The next exhibit is of Drewry light "Alpha" type inspection trolley. This is fitted wtih a 6 h.p. twin-cylinder air-cooled B. A. S. engine and gear box mounted as a separate unit, so that it can be instantly detached from the chassis. The complete trolley weighs about 5½ cwt. of which the engine and transmission unit weighs 3 cwt. The detachable unit enables the trolley to be very readily and quickly cleared from the track or to be loaded into an ordinary brake van, the seat and power unit being lifted off the chassis after which the chassis itself can be turned up on end and passed through the door of the van. This is a valuable feature and will be particularly appreciated by district and other engineers who have to travel long distances for inspection purposes.

The Drewry Car Co., Ltd. also supply trollies similar in all respects to the "Alpha" type, with the exception that the power unit is not detachable. They can be supplied to suit any gauge and, like the "Alpha," can be fitted with engines varying from 4 h.p. up to 8 h.p. according to the duties and conditions under which they are required to operate.

The locomotive exhibited is Drewry 20/25 h.p. standard type. It is built to a 60 centimetre gauge with a wheel base of 2-ft. 9-in. and is therefore able to successfully negotiate very sharp curves. The under-frame is constructed on steam locomotive lines, the plate frames being ⅝-in. and the buffer beams ¾-in. thick. The driving wheels are of cast steel 1⅛-in. in diameter, the thickness of the treads being 1¾-in. The axles are of steel to main line specification and have journals 3-in. diameter by 5¾-in. long. All wheels are coupled and are driven by side rods mounted on outside spur wheels which are driven by pinions keyed to either end of a cross shaft. This shaft is fitted with a bevel reverse gear. The whole of this reverse gear is enclosed in the casing and is thoroughly protected from dust and dirt.

The locomotive can be driven at two speeds by means of Drewry patent duplex clutch and gear box. This transmission is designed for simplicity and especially to eliminate the difficulty in changing speed when climbing a gradient with a load. There are no gears to disengage and re-engage when speed is being changed. The clutches are attached direct to the gears which are in constant mesh, and are operated by a clutch drum which revolves with the engine. To operate the locomotive after the engine is running, all that is necessary is to push the speed lever into the low gear position and, when changing to top speed, to pull it into the top speed position. There is no clutch to disengage before changing gear, only one lever to push or pull as the case may be, the ordinary engine clutch and clutch pedal being entirely dispensed with. The advantage of this form of transmission is that the speed can be changed going up or down an incline without danger of missing, the change being made instantly without shock or loss of momentum, and the locomotive can be successfully operated even by an inexperienced person.

The engine is mounted at the rear end of the frame. This is a four-cylinder engine having a bore of 4-in. and a stroke of 5-in., and develops 20/25 h.p. while the fuel consumption is about ¾ of a pint per b.h.p. per hour.

The cylinders are cast in pairs and liberal water jacket space is provided. The valves are of nickel steel. are positively operated and adjustable tappets are provided. Forced lubrication is employed and cooling is effected by means of a rotary pump in conjunction with a large capacity water tank containing 130 gallons of water. Ignition is by means of a high-tension magneto.

The total weight in running order is about 4 tons and locomotives of this type are manufactured by us in sizes ranging from 10 h.p. up to 150 h.p. suitable for any gauge from 2-ft. 0-in. and upwards.

The Drewry Car Co., Ltd., manufacture railway and tramway motor cars from a 4 h.p. light trolley up to main line bogie passenger coaches, and are therefore able to cater for a very wide range of requirements.

As our readers are no doubt aware, these locomotives, cars and coaches are very well known to railway engineers all over the world, and the company have innumerable testimonials from actual users expressing their satisfaction at the thoroughly reliable service which Drewry cars have given, in many cases over periods of ten years and more.

Preheating Boiler Feed Water with Waste Heat

By John F. Welch

WHILE the descriptive phrase "feed water heaters" may be taken as covering a type of apparatus of comparatively recent application to locomotives, the heating of locomotive boiler feed water has been common practice for a long time. Increasing the temperature of feed water as taken from the tank has been in use on locomotives for nearly three generations and it is doubtful if any locomotive built in the United States during the past thirty years did not have a feed water heater. The device referred to is, of course, the injector.

The first feed water heater (as recognized by the term) was proposed in the United States by Col. S. H. Long, in 1832, and applied to Baltimore and Ohio locomotives, by Ross Winans, about 1836. Very little attention was thereafter paid to it in the United States, where it became virtually a "back number," although it was applied to a considerable extent in Europe, with results than can be conservatively stated as effecting a fuel saving of 12 per cent. or more. It may now be said to be an element of standard European practice, where fifteen thousand are in regular service. From the performance in regular service of the latest design which has been produced in the United States and the trend of public sentiment as to the necessity of fuel economy, there is no room for doubt that it has come back, and back to stay.

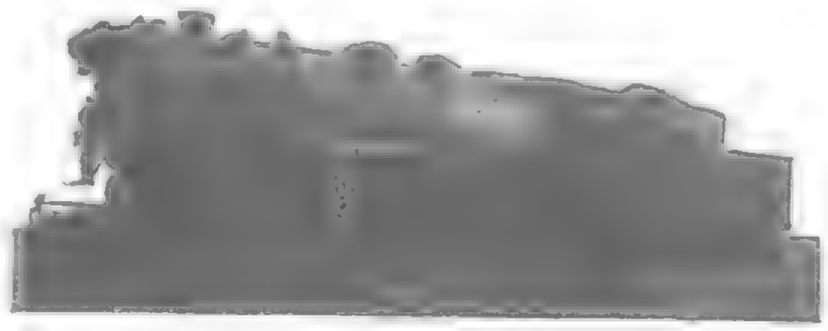
The sole object of the feed water heater is not so much the final temperature that can be obtained, but the reclaiming of waste heat that is now lost at the stack.

Since the locomotive is a prime factor in railway operation the history of its development makes it a materialistic romance and it has no parallel in the records of human achievement nor can too much credit be given the men whose stupendous labors brought into practical form the most potent forces of nature that has ever been subdued for the use of the human race.

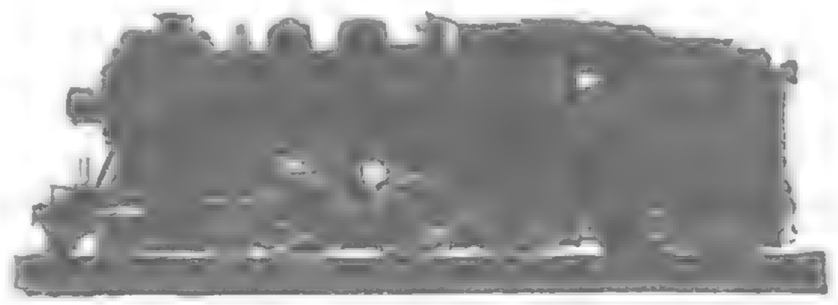
The expensive mistakes in the development of steam engines have, no doubt, caused, to a certain degree, the delay in applying meritorious devices, but now that the committee of the traveling engineers' association on the subject of preheating, has rendered a report to the effect that over one-third of the new locomotives ordered between March 1, 1922, and May 1, 1923, were equipped with feed water heaters and, in addition, that a number of railroads are applying feed water heaters to their locomotives when they are overhauled, thus clearly indicating that this appliance has attained a high standing among railroad authorities, the adoption thereof will be more rapid and shortly become universal.

Preheat has been given a vast amount of attention by engineers in the development of same, particularly in respect to *boná fide* test covering practically all branches of service, and it does seem, since we can trace back to the year 150 B.C. and find that the people of those times were trying to economically use the power obtained from steam for mechanical purposes, that we of this age would avail ourselves of the opportunities offered, by at least reclaiming wasted heat and using it in preheating.

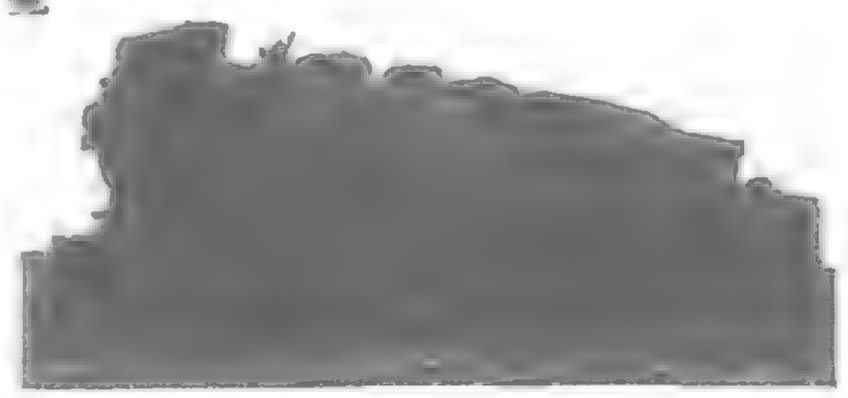
Chesapeake Type Simple Articulated 2—8—8—2 Locomotive Elesco Equipped (Chesapeake and Ohio R.R.)



Mikado Locomotive with Elesco Feed Water Heater



Suburban Type Locomotive with Elesco Feed Water Heater



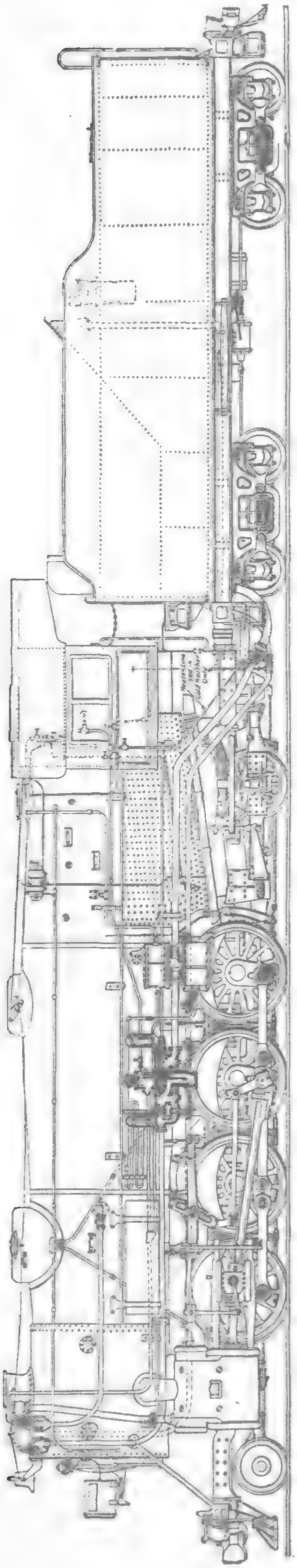
Transfer Locomotive with Elesco Feed Water Heater

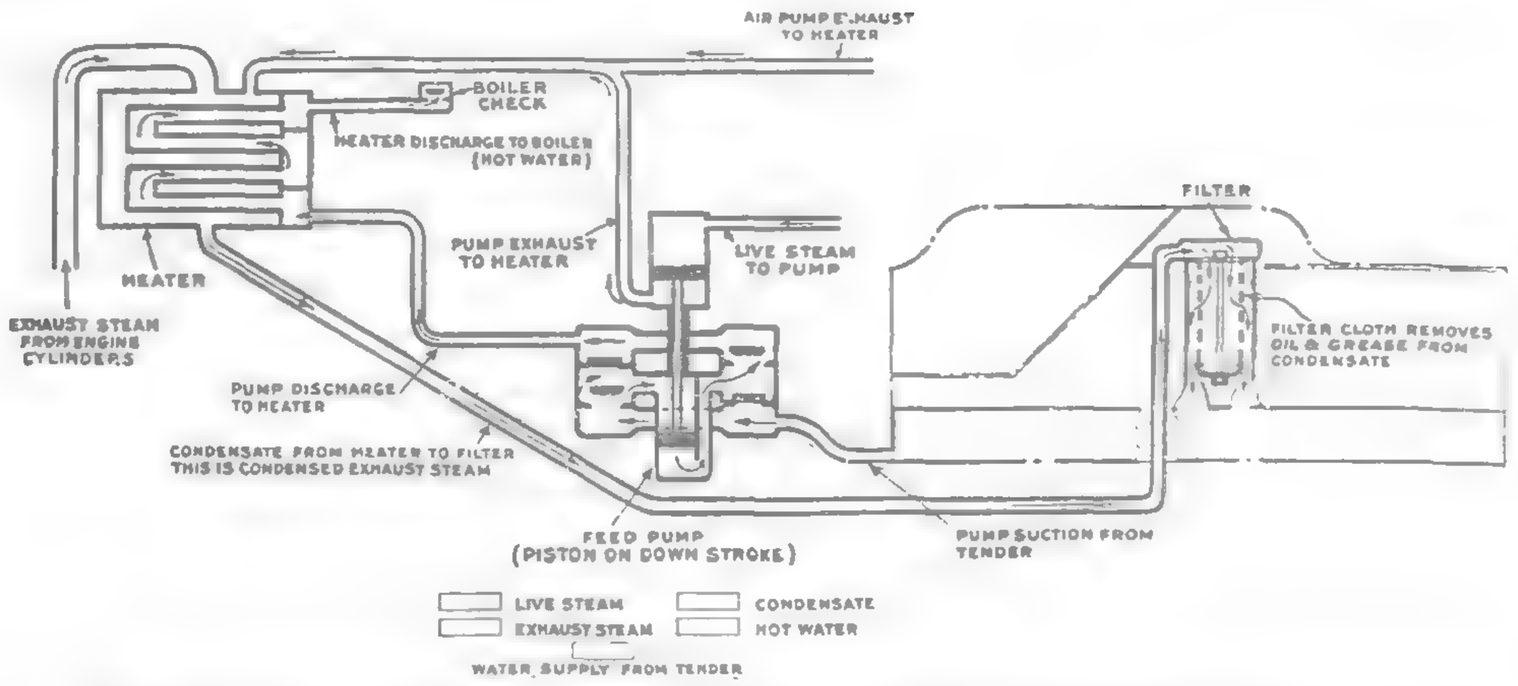
In speaking of economy, it might be well to consider what the application of a feed water heater to a locomotive results in. There as three things: first, it reduces the amount of coal required to produce the required amount of power; second. it increases the available water supply; and third, it reduces the amount of back pressure on the piston, thus making the locomotive earlier in action and more powerful. These gains are all very real and have also been endorsed by the traveling engineers' association.

In a series of test runs made recently and as reported by the railway and locomotive engineering with the conditions of speed, cut-off and steam pressure as near exactly alike as possible, cards were taken and the comparison developed the fact that 3¼ per cent. less steam was required to give a unit of work with the heater than without at a speed of 10 miles an hour, and over 6 per cent. at from 35 to 43 miles an hour.

Engineers in power plants frequently express surprise that locomotives are not generally equipped with feed water heaters. As the locomotive is one of the largest consumers of fuel in the United States, it would appear as if this would be the first place where so well an established and economical practice as feed water heating would be in general use. Whatever the reasons may have been, we are now at last well on the road towards establishing the art of preheating boiler feed water as a standard on American railroads.

In principle, feed water heating is exceedingly simple. A portion of the exhaust steam is led to the heater through which water from the tank is circulated





These drawings serve to illustrate the various passages of steam and water as well as the principle of utilizing waste heat for preheating boiler feed water through the medium of Elesco Feed Water Heaters. The arrows on either drawing indicate the operation of the heater

by means of the pump. Heat from the exhaust steam is transmitted to the water, raising its temperature before passing to the boiler. Therefore, by utilizing heat which would otherwise be wasted at the stack to preheat the boilers feed water, a portion of the work ordinarily performed in the boiler by the combustion of fuel is accomplished. Thus the boiler is relieved of part of its work, and less fuel is consumed for the same steam output of the boiler.

One per cent. of steam economy is obtained from every 11 per cent. increase in feed water temperature. This easily checked and simple rule of thumb is a convenient method of determining the advantages of a feed water heater. The steam used by the feed pump should be deducted from the saving in steam due to the reclamation of heat otherwise wasted.

Any water heating device utilizing exhaust steam effects a reduction in the exhaust pressure against which the engine piston works, or, in other words, produces a condenser action. This reduction in back pressure increases the mean effective pressure and, therefore, the power delivered at the rim of the drivers. It has been found that this increase in power equals or exceeds the power required by the boiler feed pump, and, when properly designed for locomotive boiler feeding, the pump requires not more than 2½ per cent. of the steam used by the cylinders. Frequently, however, the increase in power, resulting from the decrease in back pressure, is as high as 6 per cent., offsetting, with a slight margin, the feed pump steam consumption. Based on the increase in feed water temperature, therefore, the calculation of saving represents a net gain from the use of feed water heaters employing a pump.

Thus a feed water heater is an apparatus designed for the purpose of making practical use of some of the heat discharged in exhaust steam. Its full object is to absorb some of this heat and return it to boiler. This point should be made particularly clear—that the object of the feed water heater is to save heat in exhaust steam that would otherwise be emitted at the stack as waste, and that the hot water coming from the heater is the result of the process and not its object. Of course, the higher the temperature of the water coming from the heater, the greater the saving, but any heating at all by the exhaust steam is a saving of some amount. Note particularly, however, that the water must be heated by heat that will otherwise be wasted, or there will be no saving. The water coming from an injector is hot—sometimes approximating the temperature of that coming from a feed water heater—but that does not mean that a saving has been made, for all live steam injectors of all makes, taking into consideration the variable sizes, etc., use a mean average of approximately 10 per cent. of the steam generated in the boiler. The heat of this steam is returned to the boiler with the exception of the negligible amount lost through radiation between the turret and boiler check; it means, in other words, that the live steam injector is pretty close to 100 per cent., but when the live steam injector is working and using, as we said, approximately 10 per cent. of the steam generated in the boiler, this amount of steam is not available for the engine cylinders, air compressors, stoker, engine booster, or other auxiliaries, as it is completing a cycle from the turret to the injector, to the boiler check, to the turret and so on, means, taking for example a boiler considered 100 per cent. good relative to cylinder horse-power, that as soon as the injector is working and you have a 90 per cent. boiler furnishing steam to the engine and auxiliaries. There is no saving by taking steam directly out of a boiler, putting it into the feed water and discharging the water and steam back into the same boiler.

In order to pick up the largest amount of heat from the exhaust steam, it is necessary to bring the feed water to the heater as cool as possible. It is for this reason that a pump is used with the heater in place of an injector. An injector would heat up the water by live steam and deliver it to the heater at a temperature which would leave little opportunity to reclaim any considerable amount of heat from the exhaust steam. For example, if the water entered the feed water heater at 150 degrees temperature, and exhaust steam could only heat it to 220 degrees temperature, it would reclaim 70 heat units for each pound of water going through the heater. If it came to the heater at 60 degrees temperature and was discharged from the heater at 220 degrees temperature, there is a saving of 160 heat units for each pound of water going into the boiler, or 2¼ times as much as with the higher temperatures.

Understand that when the heat is removed from the exhaust steam in the feed water heater, the same is changed back to water. The water formed in this way is generally referred to as condensate, and is returned to the tender cistern and filtered for further use.

The closed type non-contact feed water heater manufactured by the Superheater company, consists of a pump, a heater and a filter. The pump and heater are located on the locomotive, while the filter is on the tender. The pump is the lighter of the two equipments on the locomotive and is attached to the side of the boiler in a manner similar to the supporting of the air pump. The heater is located on top of the boiler, just ahead of the stack. This is a point where the additional weight is frequently of advantage and the weight of the heater is equalized on both sides of the locomotive.

The pump is the only part of the feed water heater equipment that is a moving piece of machinery. The heater and filter are without moving parts and without wear. Therefore, from the standpoint of reliability and cost of maintenance, the pump is the most interesting and important part by far.

With this in mind, the engineers who developed this heater arranged to use the standard steam end of the Westinghouse locomotive air compressor for the steam end of the water pump. This is of great advantage from a maintenance standpoint, as it provides an equipment thoroughly understood by all roundhouse and shop forces, as well as by the engine crews. It also provides an apparatus which has already been tried out in locomotive service.

Next in importance is the heater. A prime requirement of the feed water heater on locomotives is that is shall give the greatest possible rate of heat transfer between the exhaust steam and feed water heater per square foot of heating surface, accompanied by reasonably low resistance to the passage of the water through the heater. This is necessary in order to get the minimum weight and size of heater. The non-contact type of heater answers these requirements to the very limit of good practice. Careful tests have demonstrated that this type of heater, with corrugated agitators, gives the greatest transfer per square foot of heating surface of any construction that has been presented for test.

The constructional features of the heater consists of a number of copper tubes, approximately 850-ft., each $\frac{5}{8}$-in. outside diameter, which are expanded into thick tube sheets at either end. These tubes are 4 feet or more in length between tube sheets and are arranged in groups so that the water makes the passage of four different lengths of tubes going through the heater, giving it a travel of over 16 feet.

Within each tube is a spirally corrugated agitator made of thin copper stripping. These agitators have stops at one end which overlap and interlock and prevent the agitator from turning in the tube. The water in passing through the tube and around the agitator is constantly impinging against the inner surface of the tubes. This results not only in the high transfer of heat per given area, but also scours the inside of the tube and helps to keep it clean.

Heavy cast iron headers are bolted to the tube plates and are arranged with partitions which compel the water to pass through the four passages in succession. These headers are easily removable for inspection if desired. One of the tube plates is larger than the other and is arranged to be secured to the end of the cast iron body which encloses the whole nest of tubes. The smaller tube sheet is allowed to move freely in a longitudinal direction within the body, and thus provides for the difference between the expansion of the copper tubes and the cast iron shell. This end of the shell is enclosed by a casing to prevent the escape of the exhaust steam around the floating header.

A part of special interest in this heater is the form of joint used for the connection of the tubes and the tube sheets. This joint includes two groups in the tube sheet about midway between the two faces, and as the copper tube is rolled, the metal is cold flowed into these grooves. Experience has shown that this construction is very practical and the likelihood for leaks is reduced to a minimum.

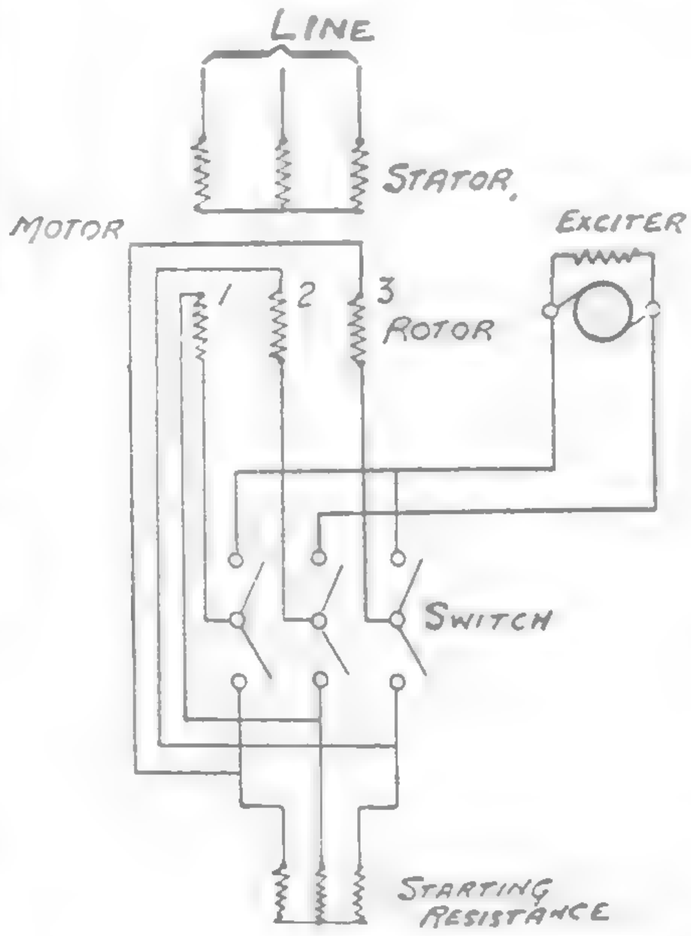
This design of feed water heater equipment has been developed after a number of years of practical experience in locomotive service, and is the result of a most careful study of roundhouse and shop conditions, as well as regular road service.

New Type of Electric Motor

A COMPARATIVELY new type of electric motor, known as the austosynchronous motor was installed last year, in the Wah Foong Flour Mill, Shanghai. This machine, manufactured by the G. E. Co. of Sweden, combines the advantages of the synchronous motor with those of the ordinary slip ring type asynchronous (induction) motor. The chief advantage of the synchronous motor is that it can be made to operate at unity power factor, and thus save the extra capacity in cables, transformers, and generating plant which has to be provided to accommodate the wattless current which is caused by the running of ordinary asynchronous motors: but its weak point is its poor starting torque.

The municipal council electricity department, keenly alive to the close relationship between good power factor and economic operation, has offered every encouragement to its consumers through advantageous power rates to improve the power factor of their demand. As a consequence, a number of ordinary synchronous motors are now installed in Shanghai, but with these special arrangement have had to be made so that they could be started up without load owing to their poor starting torque.

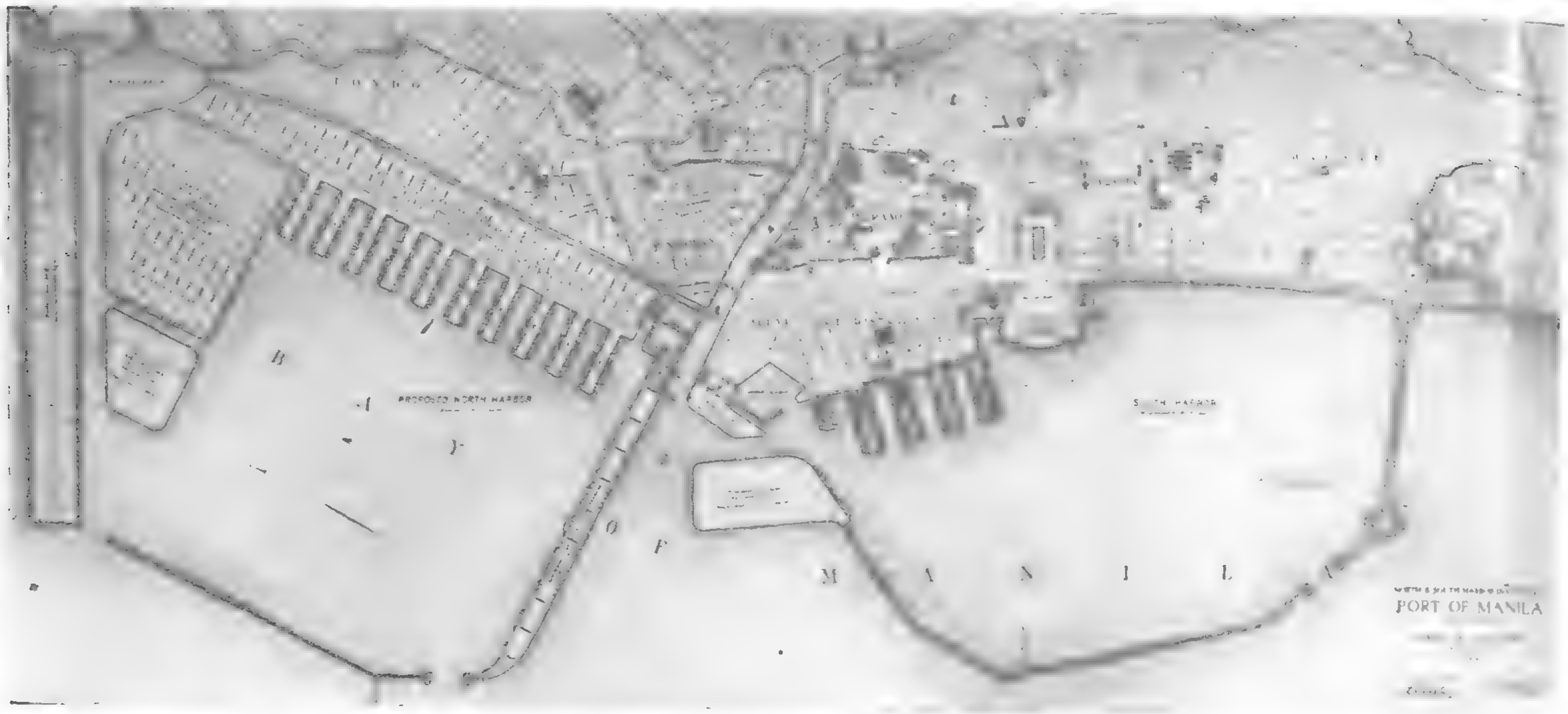
The autosynchronous motor, however, starts up as an asynchronous motor with the resistances inserted in the rotor circuit and can thus start against any load which the ordinary slip ring motor can start up against, and then, on attaining full speed a change-over switch disconnects the resistances and connects the slip ring to an exciter mounted on the shaft of the motor and thus converts the rotor of the motor into a separately exited set of field magnets and the machine is thus converted into a synchronous one and pulls itself into step automatically.



Incidentally it may be mentioned that, if during running such a machine is over-loaded to the point of falling out of step, it automatically runs as an asynchronous motor until the momentary overload is removed when it automatically pulls itself back into step again.

The machine in question is of 400 h.p. running at 300 r.p.m. direct coupled to the main line shaft of the mill and is supplied with power at 6,000 volts. A doubt was felt by some before the motor was put to work as to whether it would start up after an emergency stop with all the stock passing through the mill, but it has been in operation for about 12 months and no such difficulty has been experienced.

We publish herewith a photograph of the machine in question, and also a diagram of connections, showing the change-over switch which converts the machine from an asynchronous one at starting to a synchronous motor during running.



PORT OF MANILA IN 1924

The Port of Manila

Rapidly Progressing as Distributing Centre for U. S. Products

THE port of Manila, centrally situated with reference to the great markets of the Orient, at the head of Manila Bay approximately 30 miles from its entrance and at the mouth of the Pasig River, has to-day a well protected harbor, deep anchorage and well equipped piers and wharves at which the largest vessels plying the Pacific may berth and rapidly discharge or load cargo with up-to-date cargo handling equipment.

The port of Manila is the principal entry port to the commerce of the Philippines; a group of tropical islands of approximately 115,000 square miles of territory, inhabited by 11,000,000 of people. The islands are rich in agricultural lands and produce in large quantities cocoanuts, cocoanut oil, copra, hemp, wood products, lumber and rubber,—all of which is exported.

Annual imports of agricultural machinery, sugar mill and railroad supplies, electrical steam and oil engine equipment as well as practically all products of American manufacture including common food stuff are heavy.

The port of Manila is ideally situated, from a distributing standpoint, to the great markets of the Orient and is rapidly progressing as a distributing and transporting centre for American products. Regular sailing schedules are maintained by lines operating from Manila to Amoy, China; Hongkong; Saigon, Indo-China; Calcutta, India; Madras, Colombo, and Bombay, India; and to Singapore, Strait Settlement, as well as to Javanese ports of Batavia, Sourabaya and Sandakan. A regular service is likewise available between the Australian ports of Sydney, Melbourne and Auckland and Shanghai and Japanese ports.

Manila Harbor

The south harbor consisting of 1,270 acres of anchorage is protected by ten thousand (10,000) feet of rock breakwater wall. Vessels anchoring within this area may load and discharge cargo throughout the entire monsoon season without difficulty and, except for short periods of heavy weather during the passage of a storm, can be safely worked throughout the year.

Pilotage at the port of Manila is optional with the master of the vessel within the harbor. It is compulsory in the Pasig river for vessels over sixty tons gross. Only coastwise vessels enter the river.

The entrance to the harbor is marked by channel bouys and light beacons. Pilotage service is available to incoming vessels from sunrise to sunset and service may be had for outward bound vessels at all hours.

The average depth of water within the approved anchorage area is 30-ft. zero tide. This depth is maintained by regularly dredging to 32-ft. Preparations are under way for dredging the entire harbor to 40 feet during 1924-1925.

The maximum range of tide is 5.2-ft., or from—1.1-ft. to+4.1-ft. This small range facilitates cargo handling at the pier considerably.

General View of Piers 1, 3 and 5, Port of Manila

Partial View of Manila Harbor

Approximately 7,000-ft. of berthing space is available at the piers and wharves—sufficient to permit the berthing of 9 or 10 large trans-Pacific vessels simultaneously. Additional berths will be made available during the year, with the completion of Pier No. 7 and in 1925 when more wharfage along the bulkhead will be commissioned.

Facilities of the Port

The port of Manila has four government owned piers and bulkhead wharfage available for the accommodation of the overseas trade with sufficient berthage for 9 or 10 large trans-Pacific vessels.

Numerous bonded warehouses provide ample storage space for all classes of cargo at low rates. Several of these warehouses are situated in the immediate vicinity of the piers.

The port is served by an extensive rail system on Luzon and by a number of inter-island steamship lines operating approximately 75 vessels. This service insures prompt distribution of imports and makes the port of Manila the export centre for the country's products.

Fueling Facilities

A large coal bunkering station is maintained by the U. S. Navy at Cavite ($\frac{3}{4}$ hour from anchorage in harbor). Ample facilities are available for coaling vessels in harbor from lighters.

All piers are piped with 10 inch. fuel lines for bunkering vessels while at berths loading or discharging cargo. Vessels desiring to take fuel oil from tank lighters may be served by pump barge at the rate of 1,200 barrels per hour.

The Standard Oil company, the Asiatic Oil company, the Texas Oil company and the Associated Oil company carry large stocks of fuel oil in bulk and refined oils in case and drum containers. The combined tankage capacity of these

PIER NO. 1 PIER NO. 5 PIER NO. 3 PIER NO. 7

Side View of Pier No. 7 (Less than half the length of the Pier is shown here)

VIEW OF RIVERSIDE

companies and that of the government exceeds three-quarters of a million barrels.

Drydock, Marine Railway and Repair Facilities

The U. S. Navy floating dry dock " Dewey " is available for the repair of any seriously damaged vessels arriving at Manila.

Two privately owned marine railways are operated at Manila for the general repair of vessels under 3,000 tons.

Ordinary repairs may be made aboard ship by a number of machine shops, including The Atlantic Gulf and Pacific Company of Manila, The Earnshaws Slipways and Engineering Company, The Varadero de Manila, The San Nicolas Iron Works and by the repair shops of the bureau of commerce and industry.

Stevedoring at the port of Manila is entirely a private business, and is not under the jurisdiction of the Manila harbor board. The Luzon Stevedoring Company and the firm of Baily and Sidford handle the overseas stevedoring of the port. Stevedoring charges there compare favorably with charges at other ports of the Orient.

General cargo worked from 4 hatches is discharged at the rate of 110 to 150 tons per hour ; coal 100 tons ; case oil 850 cases and lumber 25,000 board feet. Vessels may be discharged or laden continuously for 24 hours per day if desired. The rate of discharge mentioned above can be considerably increased if necessary to turn a ship around within a specified time. The Luzon Stevedoring company recently made a record at Manila in handling 7,800 tons

Aerial View of Port District, Port of Manila

PING, PORT OF MANILA *Photo by Denniston, Inc., Manila, P.I.*

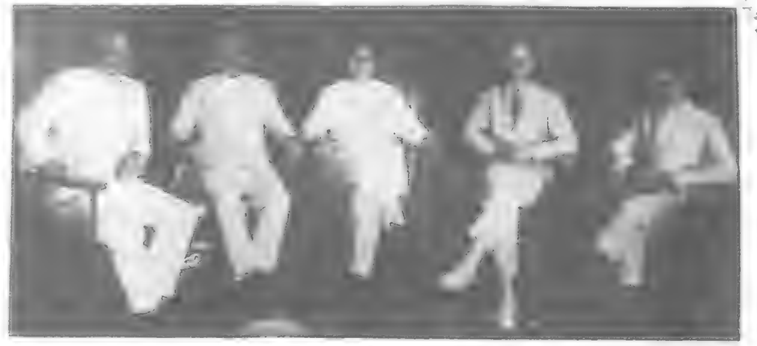
of general cargo aboard one of the " President " type of vessels within a period of 42 hours. A similar record was made in the past year when 23,000 cases of oil was discharged from one vessel in 9 hours.

Sixteen modern exterior semi-portal gantry cranes and 52 interior overhead electric cranes are to be added to the equipment of Manila and will soon be available for further expediting the discharge and loading of vessels there. Half of this interior equipment has just been commissioned.

Heavy Lift Facilities

Heavy lifts up to 20 tons can be handled at the new concrete pier (Pier No. 7) with the semi-portal electric gantry jib cranes which operate over the apron of the pier. Lifts may be discharged from vessels directly on to flat cars or barges.

Ample floating facilities are available for heavy lifts up to 75 tons. There are two 20-ton floating derricks, one 30-ton and one 40-ton floating derricks, privately owned and operated. A 50-ton floating derrick is owned by the insular government, and a 75-ton floating A-frame is maintained by the Philippine division of the United States army. The latter can safely handle 50-ton lifts and with special rigging and management can handle 75 tons. Vessels contemplating the transportation of lifts in excess of 50 tons should communicate with their agents at this port, prior to the acceptance of such cargo, with a view to having special arrangements made for the handling of same upon arrival.



MANILA HARBOR BOARD

Left to right: Mr. A. B. Cresap, Secretary; Col. H. B. McCoy, Vice-Chairman; Mr. Vicente Aldanese, Chairman; Mr. J. F. Marias, Treasurer; Mr. E. C. Earle, Port Works Engineer, Member

Lighterage Facilities

Lighterage at the port of Manila is privately owned and is not under the jurisdiction of the Manila harbor board. There is approximately 40,000 tons of covered and 25,000 tons of open deck lighterage available for general cargo. In addition, about 20,000 tons of lighterage is used for coal handling and when necessary can be used for general cargo. The tonnage is ample to assure adequate service at all times to vessels loading or discharging at Manila

Tank lighterage for about 24,000 barrels of fuel oil is available. A pump-barge, privately owned and operated, handles fuel oil at the rate of 1,200 barrels per hour. Service is continuous 24 hours a day.

Tank lighterage for about 17,000 barrels of cocoanut oil is available. A large pump-barge, privately owned and operated for general public service, handles 1,600 barrels per hour from tank lighters to vessel.

Facilities are available for cleaning tankage preparatory to receiving cocoanut oil and heating coils may be quickly installed by local concerns.

Vessels arriving laden with bulk cargo such as flour, case oil, cement, coal, fertilizers, etc., consigned to companies owning warehouses on the Pasig river, usually anchor in the stream and take advantage of the ship-side delivery permit discharging cargo into covered lighters, cascos or upon open barges. A large proportion of the exports of the port are moved directly from warehouse to ship by lighters.

Federal Terminal

Pier No. 1 is 550-ft. long and 60-ft. wide, covered with a transit shed 500-ft. by 52-ft. Piped for fresh water and bunker fuel oil.

Equipment : Hand trucks ; flat cars ; electric industrial trucks ; tractors and trailers.

Water : Thirty feet at zero tide.

Operation: Owned and operated by U. S. Government for use of army and navy.

Wharf A is an open wharf 350-ft. long.

Water : Eighteen feet at zero tide.

Operation : Owned and operated by U.S. government for use of army and navy.

Partial View of Cargo Sheds, Port of Manila

Insular Terminals Publicly Operated

Pier No. 3 is 670 feet long and 70-ft. wide, covered with a transit shed 550-ft. by 60-ft. Piped for fresh water and bunker fuel oil.

Equipment: Hand trucks; flat cars; overhead traveling electric cargo hoists; electric industrial trucks, tractors and trailers.

Water: Thirty feet at zero tide.

Operation: Publicly owned and operated under contract by Manila Terminal company under supervision of the Manila harbor board.

Pier No. 5 is 720-ft. long and 110-ft. wide, covered with a transit shed 600-ft. by 100-ft. Piped for fresh water and bunker fuel oil.

Equipment: Hand trucks; flat cars; overhead traveling electric industrial trucks, tractors and trailers.

Water: Thirty feet at zero tide.

Operation: Publicly owned and operated under contract by Manila Terminal Company under supervision of the Manila harbor board.

Pier No. 7 is to be 1,400-ft. long (700-ft. now completed and in commission) and is 240-ft. wide, covered with a transit shed 1,253-ft. by 160-ft. Piped for fresh water and bunker fuel oil.

Equipment: Hand trucks; flat mechanical stackers and conveyors; 15-ton exterior electric semi-portal gantry cranes; 50-ton locomotive cranes; 3½-ton interior overhead electric cranes; electrical industrial tracks, tractors and trailers.

Water: Thirty-five at zero tide.

Operation: Publicly owned and operated under contract by the Manila Terminal company under supervision of the Manila harbor board.

Drydock "Dewey" at Olongapo

Earnshaw's Docks & Honolulu Iron Works Marine Railway, Port of Manila

Interior View, Pier No. 5, Showing Overhead Traveling Cargo Handling Hoist

Bonded Warehouses, Port of Manila

Fuel Oil Facilities, Port of Manila

New Modern Terminal Structure Opened

The recent commissioning of a portion of the ports' newest and most modern terminal structure, Pier No. 7, marks an epoch of great importance in the development of the ports' harbor improvement program which has for its objective the making of Manila "The Trade Centre of the Pacific." The new structure is one of the finest of its kind in the Pacific Ocean and will have berthing capacity sufficient to accommodate four of the largest type of vessels plying the Pacific such as the *Empress of Canada* and the President steamers. The structure is 240-ft. wide and when completed will be 1,400-ft. in length. Its cargo capacity will exceed that of the largest pier at this port (Pier No. 5) by about six times. The structure is provided with the most improved and up-to-date type of cargo handling equipment, second to none, which will enable ships to clear in practically two-thirds of the time now required. The equipment consists of large exterior semi-portal Gantry electric cranes for removing the cargo from the ship's hold to the apron of the pier; to waiting cars or to the platforms of industrial trucks, etc., and *vice-versâ*. Within the transit shed there has been installed a flexible system of overhead electric rapid hoisting and stacking cranes which are capable of moving both longitudinally and laterally. Industrial

trucks. tractor and trailers are used to rapidly relieve the apron of its freight. Additional to the equipment and facilities above mentioned, the pier will have ample waiting room space and other conveniences for the use of passengers as well as space in the pier head for the use of customs officials engaged in the examination of baggage including offices. A large and convenient baggage room, has also been provided. A novel feature of the new pier is the overhead passenger passageway which runs along the outer edges of the transit shed at the second level. The use of this passageway is to enable passengers to reach the ship's deck without the necessity of passing through the more or less dangerous areas utilized for the loading, unloading and storage of freight. Ships' decks are reached by ascending the stairs on either side of the waiting room in the pier head or by using the elevators situated adjacent to the baggage room, and thence by passing through the overhead passageway to a movable bridge connecting the passageway with the deck of vessel. Rail connections will link the new terminal structure (Pier No. 7) up with all points on the Manila Railroad Company lines and with local warehouses.

Wharf "B" is 750 feet long and 100 feet wide, covered with a transit shed 750 feet by 85 feet. Piped oil.

Equipment: Hand trucks; electric industrial trucks, tractors and trailers.

Water: Twenty-two feet at zero tide.

Operation: Publicly owned and operated under contract by the Manila Terminal Company under the supervision of the Manila harbor board.

Following is the report of the harbor board:—

June 1, 1923.

To His Excellency,
THE GOVERNOR GENERAL,
Manila, P. I.

SIR,—The Manila harbor board, created by Act No. 3002 of the Philippine legislature, has the honor to submit the following report of its operation for one year from June 1, 1922 to May 31, 1923:

Organization of the Board

The board was organized March 7, 1922, as heretofore reported, and has held twenty-five meetings. The board consists of the following members:—

Mr. V. Aldanese, chairman
Col. H. B. McCoy, vice-chairman
Mr. A. B. Cresap, secretary
Mr. F. J. Marias, treasurer
Mr. E. C. Earle, member

Method of Operation

Pursuant to the provisions of Section 13 of Act No. 3002, the board, on May 31, 1922, entered into a two-year contract with the Manila Terminal Company, Inc., a local corporation, for the receiving, handling, custody and delivery of all merchandise, imported or exported, over the piers and wharf at the port of Manila.

The Manila Terminal Company, Inc., began operations under the terms of their contract on June 1, 1922, since which time, necessary regulations have been issued by the board, and accepted by the contractor, modifying somewhat the original provisions of the contract.

Limits of Authority of Board

Under the provisions of Act No. 3002, the Manila harbor board is limited in its activities solely to the general supervision, control and regulation of the receiving, handling, custody, and delivery of merchandise on the piers and wharf at the port of Manila, and to the fixing of the charges therefor.

Supervision of Work of the Manila Terminal Co., Inc.

The supervision and inspection by the board of the work of the Manila Terminal Company, Inc., has been continuous as to its activities; and the manner of handling merchandise, preventing congestion, keeping piers and wharves clean and accounting for its income. The result of the work accomplished by them, has exceeded all expectations in every way.

Results of Board Work

Quicker dispatch in handling cargo onto and off the piers; accurate checking of all cargo handled; a reduction of short landed cargo to an almost negligible quantity, the prompt report of bad order cargo which is now given special care in handling; the prompt settlement of claims for cargo damaged in handling; the keeping of the piers and wharves clean, and the elimination of congestion on the same.

These matters have all been handled promptly and to the satisfaction of all concerned, shippers, shipping companies, customs authorities and the public. All claims made have been settled promptly and equitably.

New Equipment

The board has ordered ten (10) new electric one-ton hoists, similar to those now in use on Piers Nos. 3 and 5, to supplement same in order to expedite the handling of cargo during periods when congestion occurs, as has happened several times during the year, and also to provide for depreciation and replacement of hoists which have been in constant operation for some years. These hoists will cost approximately P.26,000.

Vessels Using Piers

During the period covered by this report, eight hundred and ninety-three vessels arrived at Manila from foreign ports. Of this number, four hundred and eighty-six, or about 54 per cent., used the piers; while seventy-two coastwise vessels used the piers during the year.

Cargo Handled

The Manila Terminal company handled 340,964 tons import cargo and 20,911 tons export cargo or a total of 361,875 tons of cargo of which shipside delivery was granted 150,150 tons and there were handled over the piers 211,725 tons.

The above figures excluded coal, liquid fuel oil and lumber which are not handled by the Terminal company.

Very respectfully,

VICENTE ALDANESE,
Manager.

Tin Mining in the F.M.S.—II

(Continued from page 609).

other, in the centre of the mine It is stated that on the north side of the gut, the pay-dirt is only 10 feet broad, and runs along the shale and quartzite face. In the gut there is said to be no *karang* at all. On the south of the gut the *karang* is wider. In the gut a mass of quartz and kaolin-rock is intrusive into the limestone. It contains patches of tourmaline and some big quartz-veins with white mica.

In the Tronoh South Mine the pay-dirt follows the junction of the shales and limestone.

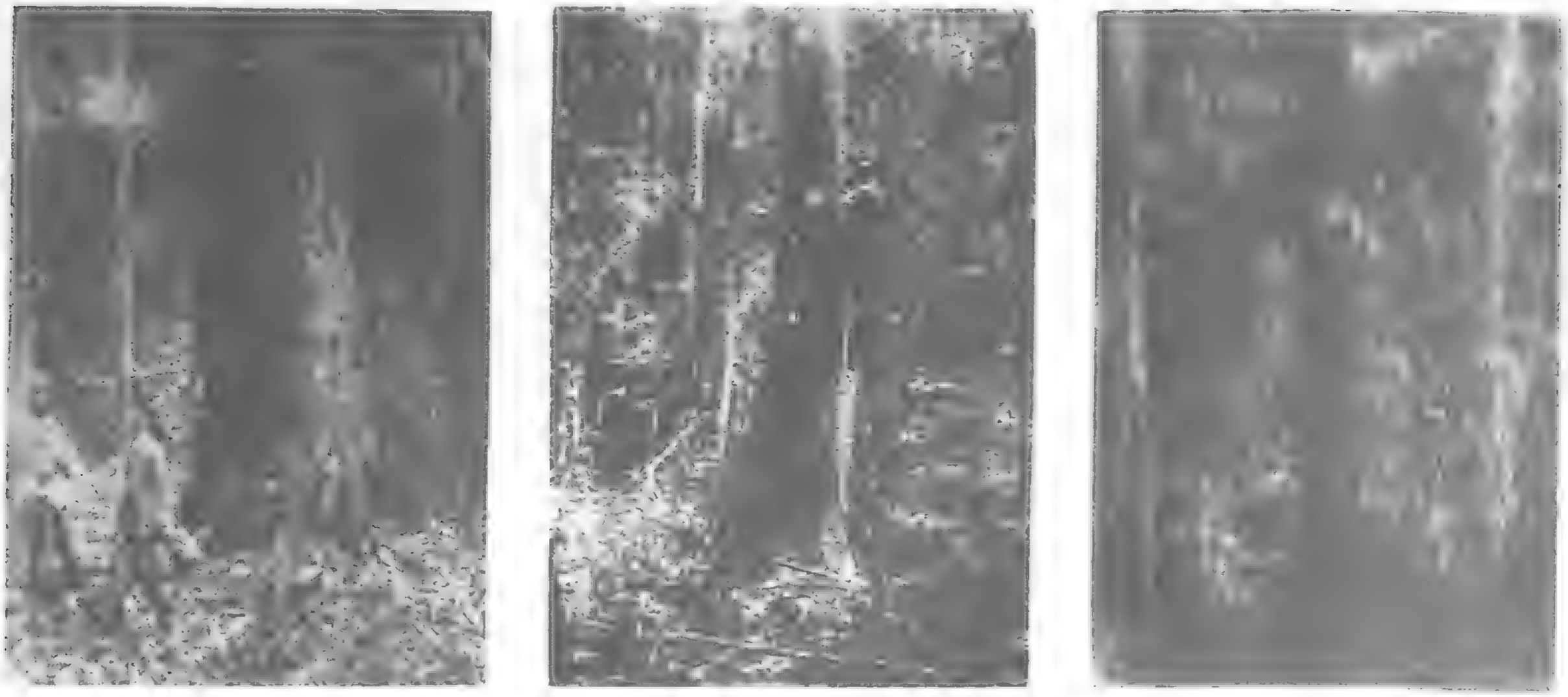
Fig. 22 is an idealized section of the Tronoh, Ltd., Mine, looking north. It will be seen that the Gondwana clays are represented as continuing up the face of the reversed fault. This is in accordance with information received; but there is no doubt that near the surface worn alluvial ore was found, which gave place in depth to the angular ore in the clay.

Ulu Piah

The mine worked by the Ulu Piah Co., Ltd., is situated in a corner of the hills near Ampang with limestone cliffs on one side and granite on the other. Over the limestone bed-rock of the mine is stanniferous clay with boulders.

Scheelite in quantities worth exporting has been found in this mine, associated with colorless flourite. There is little doubt that it occurs in the limestone *in situ*, and in 1914 a vein was seen composed of flourite and scheelite, and the appearance of the fluorite led to collecting a quantity in order to utilize it for the production of hydrofluoric acid when supplies seemed uncertain. It was found, however, that it contained both silica and boron in sufficient amounts to make it useless for this purpose. The boron was present, it is believed, as a constituent of axinite.

In April, 1915, a contact between the limestone and white non-porphyritic granite was exposed in this mine. In the granite were veins of purple axinite and green epidote and at the contact was a band of rock about 3 inches thick, 2 or 2½ inches of which on the granite-side consisted of fine-grained pink garnet, while the remainder, next the limestone, was a pale-green idocrase.



Gathering Damar Penak in the Forest of Malaya

The Damar Industry In the F.M.S.

IN his annual report on forest administration for the year 1923 the conservator of forests (Mr. E. Cubitt) says that the departmental working of *damar penak* (or *damar chengal*) has now been thoroughly established in Negri Sembilan, but progress in the other states is disappointing owing to the almost entire lack of suitable labor. Even in Negri Sembilan the output is far below what was expected, but lack of quantity is made up for by excellence of quality.

The grades adopted by the department were quickly established, and sales are now made to Europe and America f.o.b. Singapore without samples, buyers being satisfied with the signed guarantee placed in each case. It is stated that the Singapore dealers are now copying the methods of the forest department, and a departmental trade-mark is about to be registered. To prevent all possibility in the early stages of the industry of any variation in quality it has been decided that all grading for export shall be done at Kuala Pilah, even though this may be rather more expensive than grading locally; local grading would necessitate a form of guarantee, and possibly a separate trade-mark for each state, which would at once invite comparison of qualities and encourage buyers to discover (or invent) reasons for lowering prices. The market now seems secure, and the outturn at present is not large enough to be split up.

Negri Sembilan had the initial advantage of an efficient, if somewhat inadequate, labor force accustomed to the work of damar tapping and brought up to climb to the branches of the largest trees, from which the best quality of damar is obtainable. This force has now been supplemented by immigrants from the Dutch Indies, fifty families of whom have been settled at Langkap under their own "raja." A small area of padi and kampong land, which may not be sold to others, is given to each settler, and $1 (2s. 4d.) is paid for each *penak* tree brought into full bearing. More than 1,000 trees have already been tapped by them, and will soon be a permanent source of income. The results of the year's work in Negri Sembilan are an indication of the possibilities of this newly-organized industry. The outturn of graded damar (including a small quantity of *damar mata-kuching*) was 125 piculs (over 7 tons) a month, including 21 piculs (1¼ tons) from Perak and Pahang.

Damar Store at Kuala Pilah

Damar Collecting Station at Kuala Pilah

Grading Damar Penak

Various Grades of Damar Penak

Varieties of Damars

Certain of the damars were further investigated by the chemists of the agricultural department, and the results show that there is little difference in chemical composition between the different commercial grades of *damar penak*, though the darker grades give a darker solution and are therefore less valuable. *Damar penak* dust, when melted and freed from impurities, solidified into a very dark mass for reasons which are obscure, and it is still hoped to discover a satisfactory treatment. Other damars examined by the agricultural department were *damar mata-kuching* and *damar siput*.

It is recorded that the industry of damar collecting in the Malay States is still in a very primitive state, although a great improvement has been made during the past two years. In time it is hoped to extend the departmental working to more of the damar producing areas of the Malay peninsula. At present the forest department can undertake to supply some 70 tons of carefully cleaned *damar penak* a year, and it is hoped that the outturn may be considerably increased within the next few years.

A writer in the *Malay Mail* gives the following description of the damar industry in Malaya. The industry, he says, consists in the tapping of the *chengal* tree, though the word "tapping" does not convey an adequate idea of the means employed for getting the *damar*—the Malay word for resin—from the tree. What is actually done is to make deep cuts on the tree right up to the hard wood, which are about a span long and four or five inches wide, and to keep renewing these cuts until the yield of damar, both in quality and quantity, is considered satisfactory. There are many kinds of damar to be found in the forests of Malaya, but the most valuable and the one which fetches the highest price in the markets of the world is the Malayan *damar penak*.

Washing Damar

The Industry To-day

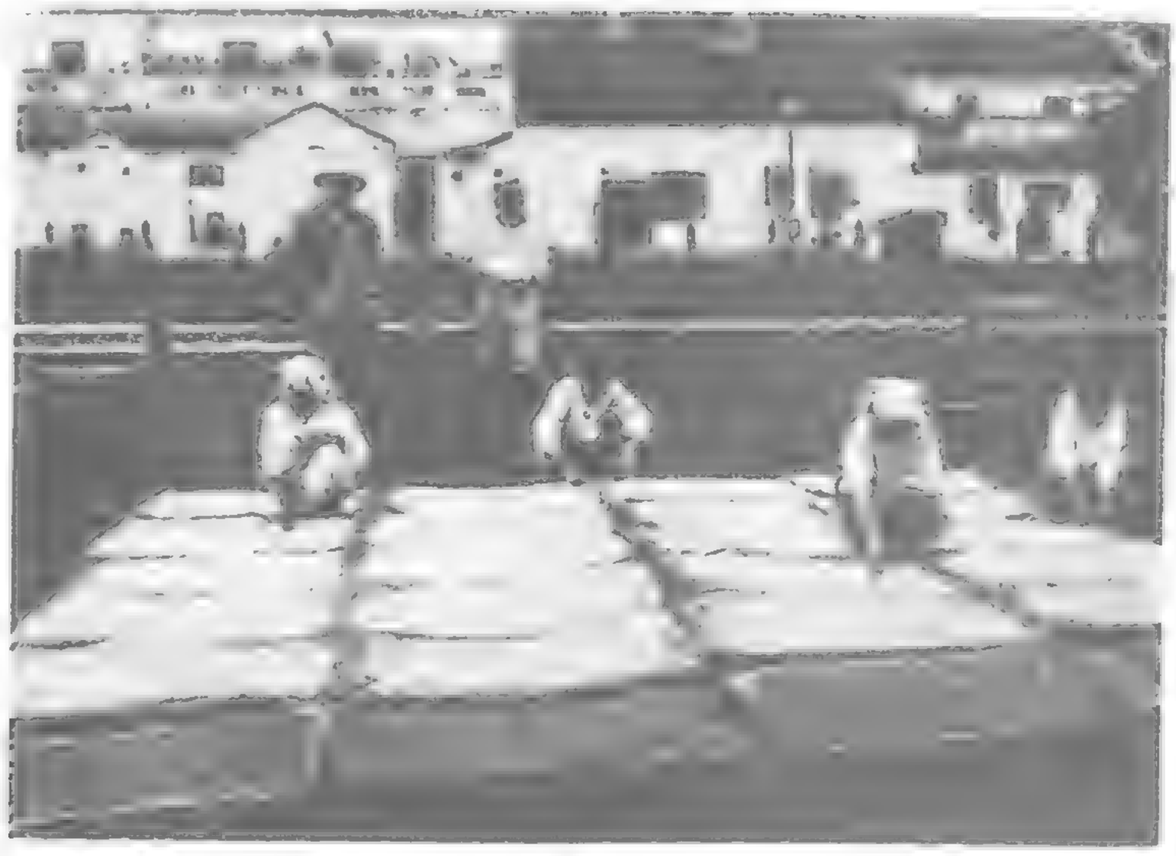
The industry, which is controlled by government through the forest department, is now well organized, and provides a large number of Malays throughout the peninsula with a handsome income, the size of which depends almost entirely on the individual enterprise and zeal displayed by the Malays themselves. The main reason why government took over the control of the industry is pos-

Sorting Damar at Collecting Station

sibly because it was anxious to preserve it as a purely Malayan one, so that the Malays might be persuaded to remain in their kampongs without roaming about the country. The industry may be said to have been established in Negri Sembilan, Johore, Pahang, and Perak, where the collection of *damar* is steadily proceeding. Every encouragement is given to the Malays to tap trees and to collect the *damar*, and the results have not been altogether disappointing, except possibly in some parts of

Sakai Women at a Damar Collecting Station

Government Officials Buying Damar from the Sakai



Sun-drying Malayan Damar

Perak. The working of the new system is in full swing, in Negri Sembilan, in the Kuala Pilah district, and it may be briefly described as follows:—Certain forest reserves and state land areas have been thrown open to Malays and Sakais who wish to tap *penak* trees, on the condition that they sell their produce to the forest department. Each man is given a certain number of trees, not fewer than twenty, and if he taps them regularly and collects the *damar* with care and assiduity he is allowed to retain the first claim upon them. Trees are tapped at intervals of about three months. As they do not yield fully until the 3rd or 4th operation the tapper is paid for this work. When he has tapped all his trees and brought them all to full maturity, which is a long and laborious process, he has to collect his *damar* and take it to the nearest receiving station, which is not far from the *penak* zones, of which there are no fewer than seven in the Kuala Pilah district. Here a forest guard receives the *damar*, weighs it, and pays cash then and there to the Malay, the rates differing according to the quality of the *damar* which is brought. The collectors are rigorously discouraged from collecting immature *damar*, *i.e.*, such as has not hardened. These cash transactions, which enable the Malay to go to the cheapest shop in the district for his necessities, from one of the most attractive features of the system adopted by the forest department. The forest guards are supplied with cash, and have to keep regular accounts of all the *damar* purchased and the amount paid out, and these accounts are regularly checked by the district forest officer at Kuala Pilah, who is supplied with funds to replenish the coffers of the receiving stations when they are exhausted. From the receiving stations the *damar* is conveyed to the central store at Kuala Pilah, where Malay and Chinese women sort the product into its various grades. This sorting requires a good eye and skill. The value of *damar* depends largely on its color, the paler kind fetching a much better price than the darker qualities. Being used largely in the manufacture of white enamel paints whiteness—or rather absence of colour—is essential. Color darkers the paint. In addition to the color, which affects the value of the *damar*, the store officers have to see that the lower grades of the products are free from chips of wood and bark. A suggestion was made that the *damar* dust which contains these foreign substances should be washed, and Mr. Kinsey, the deputy conservator of forests, Negri Sembilan, devised a washer which is achieving the object admirably, although it cannot be said to be perfect.

It is capable of improvement, and in course of time it may be possible to market a dust free from the minute black foreign matter which disfigures it at present. At the store the *damar* is packed in strong wooden boxes made to contain 140-lbs. in each, and carefully fastened with iron hoops, and then despatched to Singapore to Messrs. Stephens, Paul & Co. Every box despatched from the store contains a printed guarantee signed by the district forest officer that the *damar* is of a certain quality, and this guarantee goes with the box to its destination. What happens there it is impossible to say, and the greatest efforts are now being made to see whether the *damar* cannot be sold direct to the manufacturers who, it is suspected, are not always getting Malayan *damar penak*, but a mixture of this with other varieties. There is considerable danger to the industry from that quarter, which will have to be combated.

Malayan Damar Penak

At Pertang, about twenty miles east of Kuala Pilah, not very far from the Pahang boundary, there is a large forest reserve where the forest department is carrying out experimental tapping on 102 trees. The *penak* tree is easily distinguishable by its huge girth, and by its long and erect trunk, which sometimes rises to forty or fifty feet from the ground before branching out. In the sample plot each of these trees is given a number on a metal disc which is planted on the foot path traversing the forest, and a careful record is being kept of the methods of tapping employed and the

extent of the yields secured by each method. A study of these results will become necessary as the industry advances.

A glance at the tree is sufficient to give one an idea of the task which confronts the climber searching for *damar*. At present *damar* collectors are not allowed to tap *penak* trees of less than six feet girth, obviously because it is surmised that trees of a lesser size do not yield either a sufficient or a good quality of *damar*. Two ways of tapping and three ways of climbing the tree are now in vogue. The two methods of tapping are :

(1) Basal or bole tapping.
(2) Branch tapping.

In basal tapping the cuts are made on the trunk, beginning about six feet from the ground and working upwards, the total number of cuts thus made on an average sized tree being about 48. They are made all round the trunk equi-distant from each other. Branch tapping explains itself. It is the more risky method, but the more popular one with the Malays. It is hazardous enough to climb the trunk and remain there until the cuts are made, but to climb the trunk and tap the branches is positively dangerous even for those who are adepts at the art of climbing. It is, however, noteworthy that the Malays prefer branch tapping because by long experience they find that from the branches they are able to gather a better and larger yield of *damar* than from the trunk.

The Tapping

Once the difficulty of climbing the tree is got over the actual tapping does not present any great problem. Whether the instrument used is an ordinary *parang* or the *biliong* the method of cutting off the bark exposing the sapwood is practically the same. The cuts are more or less deep gashes, concave above and convex below. This hollowness of the cuts prevents the exudation from the tree from falling to the ground. In the branches, when such cuts are made, the *damar* forms into a kind of stalactites. About a month or more after the first tapping the blazes have to be reopened, and sometimes later the cut has to be cleaned up once again. In fact the first results are not available in less than three months. This, at present, is supposed to be the yielding period of the *penak* tree. After the first three months the yield is not very great, but it increases with each tap until it might be from 40 to 50 katis per tree. It is not yet possible to say with any degree of certainty at what stage the tree yields its highest, but experiments are being carried out to this end. It might be asked how the tappers could maintain themselves if they have to work only once in three months. The system adopted by the forest department is roughly as follows: In the Kuala Pilah district, which I have seen, the tappers live in their own kampongs, and the *penak* trees which are given over to them for tapping are not far from their houses. If we take a man who has been given twenty trees to tap we find that he does not tap all of them at once. He distributes the work evenly over three months. That means he will tap ten trees in the first month, ten in the next month, in addition to cleaning up the cuts which he had made during the previous month, and ten in the third month. By the time the last ten trees are tapped the first ten would be producing *damar*, and in the sixth month all his twenty trees would be producing, the first ten probably much more than the last ten. In about twelve months all his trees would be in full bearing, but it would not take more than say half a month to collect the *damar* from all these trees. Thus he has a sure income of about twenty dollars per month, while he has fifteen days at his disposal to devote to his other agricultural pursuits, from which he can make something extra if he is enterprising enough.

Collection of the Damar

Now we come to the *damar* proper. *Damar* exudes from the cuts in the shape of a sticky substance, which becomes harder the longer it remains on the tree. Every effort is being made in the Kuala Pilah district to discourage the collection of immature *damar*. Sometimes the collectors are prone to bring immature or soft *damar*, which is often confiscated and not paid for. The general requirements of the department are now being gradually understood by the Malays, and the amount of such immature *damar* which is brought to the collecting stations is very little indeed. They are beginning to understand that it pays them better to bring the best quality possible because they are paid higher rates for these and lower rates for the lower grades, and they get nothing for the immature *damar*.

Collecting Stations

For the convenience of the collectors, collecting stations have been established at various central spots in the district, easily accessible to the Malays living in the *damar* zone. These stations are open all day and are in charge of senior forest guards who are entrusted with a certain amount of cash for payment to the collectors. *Damar* is regularly brought, and weighed by the forest guards with *dachings*. Payments are made on the nail at the prevailing rates, and the signatures or the thumb-marks of the collectors are obtained on vouchers which are frequently examined by the district forest officer, who has to replenish the cash deposits at the collecting stations. The accounts are so well kept, and the system which has been adopted is so accurate, that a perfect check is possible on all transactions.

From the collecting stations the *damar penak* is brought to the central store at Kuala Pilah, where expert female labor is employed in the sorting and grading of the product before exportation. The forest department has rented out from the railway a carriage shed which answers the purpose of a store admirably. Here, under the supervision of the district forest officer, the *damar*, as it comes from the collecting station, is distributed among the women who, by long experience, are able to sort it out in the various qualities which are exported. There are Malay, Chinese, and Tamil women employed in this work and those who are experienced earn good money. In Kuala Pilah it is not difficult to get this labor, and as the output of the other states increases it will become necessary to find more room for the work. At present the shed which is being used is almost overcrowded.

The treating of the *damar* for the whole of Malaya is done at Kuala Pilah. This excellent proposal, for the concentrated treating of *damar* at Kuala Pilah, ensuring a uniformity of grading, came from the deputy conservator of forests, Mr. Kinsey, because he knew by long experience of the district that Kuala Pilah was the most suitable home for the treating of *damar* owing to the fact that there is plenty of labor there used to the work for years. There are one or two women manders in the store who keep a sharp look-out to see that the sorting is carefully done. The sorters have to guard against many devices employed by some collectors. For instance, in the early stages it was not uncommon for the Malay collectors to pick immature *damar*, and after storing it in their houses for some days to try to pass it off as mature *damar*. This ruse might succeed with the forest guard at the collecting station, and might also succeed at the store if a careful watch were not kept.

Of the other states Pahang and Johore are increasing their outputs considerably and in a short time the capacity of the present store will be fully taxed and it might even be necessary to establish a separate administration for the *damar* industry under the control of the forest department. Kuala Pilah is the home of the *damar penak* industry and the success which has so far been achieved is undoubtedly largely due to the keenness and expert knowledge which has been brought to bear on it by the deputy conservator of forests, Negri Sembilan, the whole administration of the store at Kuala Pilah reflects the importance attached to business-like methods.

The laborers employed in the *damar* industry at Kuala Pilah in 1923 numbered 302 (217 Malays 40 Sakais and 45 Mendiling or Sumatra Malays). The labor force this year has been 328 (246 Malays, 26 Sakais and 54 Mendilings). Last year the number of trees tapped was 5,590 and this year 7,247. There are eight *damar* zones in the district containing about 20,000 to 25,000 chengal trees. If all these could be tapped the employment of between 600 and 800 people would be possible. That would average about 30 trees per man and average monthly output would be about 2,000 pikuls. The output of the store last year was 1,504 pikuls of which nearly 1,248 pikuls came from Kuala Pilah, 194½ from Pahang West, and the balance from Pahang East, Perak North and Perak South. From January to July this year the output has been over 1,281 pikuls of which 943 came from Kuala Pilah, and 247 from Pahang West. Last year the revenue from Malayan *damar penak* was $87,532.50 and expenditure $40,270.28. Up to July 31 this year the revenue has been approximately $56,278.63 and expenditure $26,248.51. The best prices which have been obtained so far are $68—for pale Malayan *Damar Penak*, $55—$76, $60 for yellow, and $45—$50 for amber.

Tin Mining in the F.M.S.* II.

Principal Mines and Occurrences of Tin Ore in South Perak

By J. B. Scrivenor, Geologist, F.M.S. Government

(*Continued from August Issue, page* 397)

The Menglembu Tin Deposits in Granite

NOT far from Mĕnglĕmbu village, in the granite forming the edge of the Kledang Range, a number of ore-bodies have been discovered that have proved of considerable value and interest. Some of these ore-bodies are veins or "lodes" in the strictest sense of the word, for instance, the veins worked for some time on the hill generally known as Bukit Kambing and the veins on the top of the high hill worked by the Chendai Consolidated Company. Elsewhere, however, the ore-bodies partake rather of the nature of the pipes of tin-ore that have been worked in Cornwall, having little extension laterally, but comparatively great depth. These pipes, or chutes, of ore are best seen on the land worked by the Mĕnglĕmbu Lode Syndicate, but before describing them it will be as well to give some account of the other ore-bodies.

The first lode worked on Bukit Kambing trended about N.E. and S.W. The dip was 32 degrees from the vertical and constant to the bottom of the workings, which reached 210 feet. The average width of the portion worked was four feet and the average yield of tin-ore was stated to be six per cent. On the hanging-wall were slickensides and on the foot-wall brecciated material with chlorite was common, so that there can be no doubt about the lode being connected with a fault. In the granite-country biotite is abundant, but in the lode it was scarce. Big felspar crystals occurred in the lode, as in the country, and although they were cut by thin veins of tin-ore they appeared practically unaltered to the naked eye. Generally speaking, the ore occurred as irregular patches and as veins. Tourmaline was common and fluorite occurred. Work on this lode ceased some time ago, although it was stated, that in the ends of the levels the ore averaged about two per cent. black tin.

In 1915 another lode was worked on Bukit Kambing. The course was 60°—240°, the hade 70° towards 330°. The vein was much like that worked formerly and evidently connected with a fault. Some purple fluorite occurred. The granite country-rock contained veins of tourmaline and a few porphyritic crystals of felspar.

On the top of the hill on the right bank of the Sungai Chendai a nnmber of veins have been prospected and are now being worked by Chendai Consolidated, Ltd. They are not far apart' they are short in horizontal extent, and some of them occur *en échelon*. An opinion is held by some, I believe, that these veins are long veins broken up by step-faulting. I examined the evidence lately in one case and found that the supposed fault-plane was a "counter-lode" and that in both the veins, connected by it, the tin-ore extended beyond the supposed fault. It is possible, nevertheless, that this objection does not apply to all the veins on the hill.

With the exception of the clear evidence of faulting in the Bukit Kambing lode, however, all the points seen in these ore-bodies can be studied in the more extensive workings and larger ore-bodies of the Mĕnglĕmbu Lode Syndicate, although here too there are signs of the ore-bodies being connected with disturbances in the granite.

The granite country on this property is strongly jointed, the joints trending about E.N.E.-W.S.W.; and the run of the veins that form the ore-bodies is, I am told, 20° E. of N. These ore-bodies lie on a band of granite about 1,000 feet long, and one of them has been followed down for over 500 feet. Eight ore-bodies have been found along this band and the manager informs me that although they are very irregular in their behavior, opening out and narrowing down as they are followed, they may be said to average in horizontal section 60 feet by 20 feet. It has been proved that two of the pipes of ore join in depth and it is thought likely that all eight will ultimately be found to join up.

There are two remarkable points about this ore apart from the pipe-like form of the ore-bodies. One of these is that the ore consists to a large extent of very minute veins running parallel and close together; the other, that except when the percentage of tin-ore is high, which seems to be due to strong impregnation from the little veins, often obliterating the latter altogether, there is no change in the felspar of the granite noticeable to the naked eye, and little change noticeable even under the microscope. Thin sections show that brown tourmaline is common in the little veins, and metallic sulphides occur also. They also show that in some cases the veins are so minute that where there is a gap in the run of ore no fissure can beseen under the microscope, between the end of the stringer of cassiterite granules on one side of the gap and that on the other.

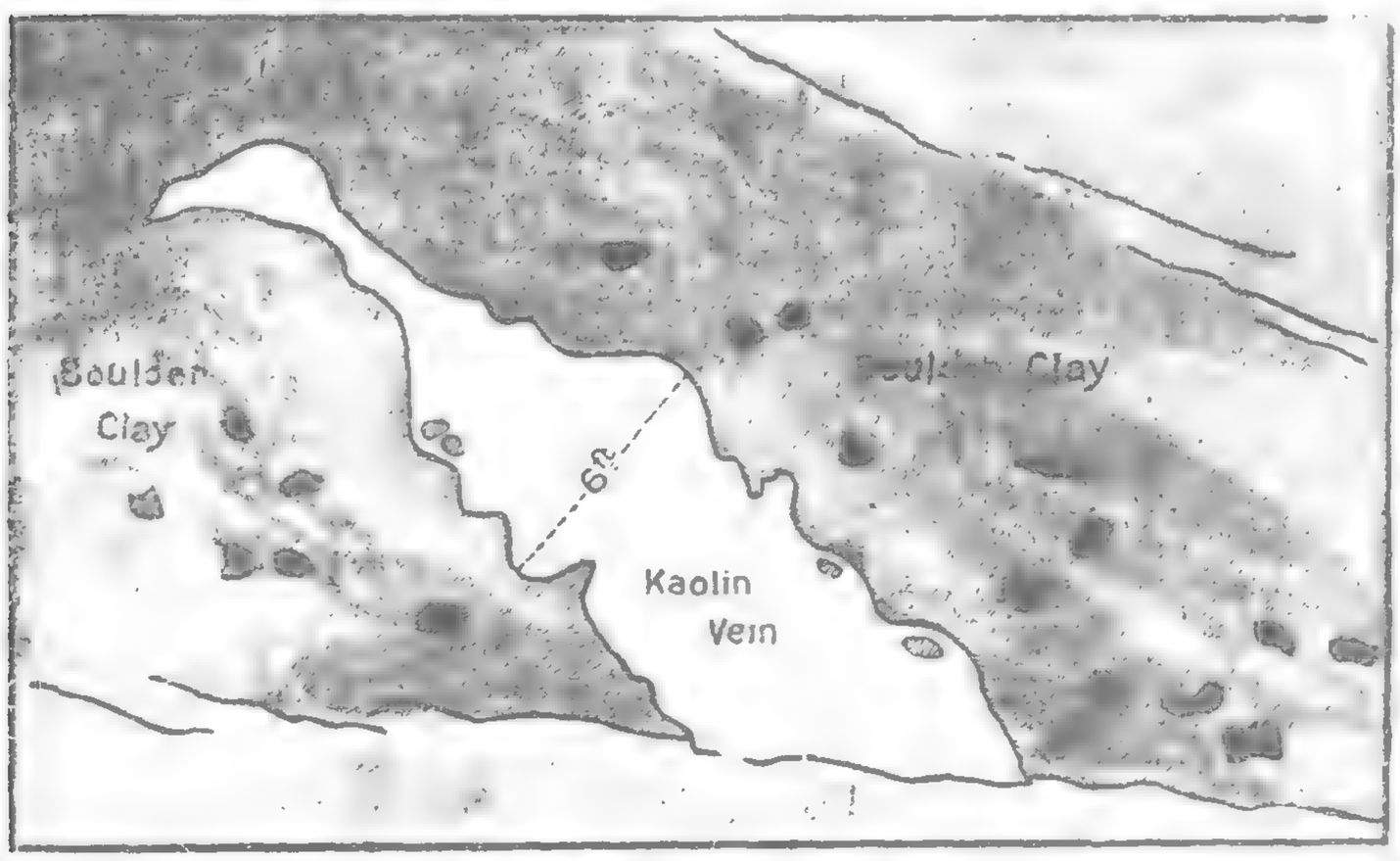
Other small veins have been opened up by Chinese in this part of the Kledang Range, and a Papan, in the gaol quarry, there is a system of tourmaline-veins in which a little tin-ore has been found.

Pulai

The Pulai tin-field is an irregular piece of flat land encircled partly by granite and partly by limestone hills. Tin-ore is found in the granite and in the crevices and caves of Koban and Lanno, but the bulk of the ore has been won from the flat land, which is a portion of the faulted limestone floor of the Kinta Valley covered by the clays and boulder-clays. The most interesting feature of these beds at Pulai is the abundance of boulders of corundum and granitic rocks. The former are very common, and the heaps of accumulated corundum in the Kramat Pulai Hydraulic Mine must run now into many tons.

In the Kramat Pulai Mine some very clear sections were seen in March, 1912, showing the junction of the granite and the clay. One section in particular attracted my notice. This (*vide* Fig. 18) showed a soft kaolin-vein intrusive into a very good example of boulder-clay. The termination of the vein in the boulder-clay was plainly visible, and on its edges were a few boulders caught up from the clay when it was intruded. I was just in time to sketch this section before it was destroyed by a monitor.

Fig. 18.



Secion of Kaolin Vein cutting Boulder-Clay close to the margin of the Mesozoic Granite, Kramat Pulai, March, 1912.

*From the Report of the Geological Department, F.M.S. government.

In 1912 a clear section was exposed of grey clay with particles of quartz and abundant corundum boulders *in situ*.

In December, 1913, there were more good exposures of the clay and granite-junction and more corundum was seen *in situ*, Some large granite-boulders were seen also, one measuring about 2 × 1½ feet. Some were *in situ* in the clay.

At this time there was a deep working resembling those at Gopeng in which limestone was exposed and also kaolin-veins cutting red clay. The manager informed me that coarse crystalline-ore was found here.

In one part of the mine there were beds of lignitic shale and clay that were evidently recent.

In 1916 a pinnacle of limestone was uncovered in which were thin veins of asbestos in the form of "mountain-leather." The composition was that of serpentine. Associated with it was purple quartz.

Pusing Bahru

In 1913 the Pusing Bahru Mine afforded the best sections of clay with tourmaline-corundum-rock boulders. Now the old excavation has been filled in with slimes and nothing can be seen of

Fig. 19.

them or of the limestone. These boulder swere particularly abundant in this mine and heaps of them can still be seen near the old puddler-site.

They occurred as boulders in a clay that is, as far as physical characters are concerned, a typical glacial boulder-clay. An interesting feature of the clay is that the fine corundum in the rock floor has become hydrated and yields a high percentage of aluminium hydrate soluble in hydrochloric acid.

The floor of the Pusing Bahru Mine was limestone. Several well-marked "cups" were uncovered, lined with the Gondwana boulder-clays and filled with sand lignite and elsewhere the limestone surface was very irregular and broken up by pinnacles.

The clays covering the limestone were generally grey or brown, sometimes showing slickensides, and the commonest boulders were those of the tourmaline-corundum-rocks. Once a vertical pipe of pale-colored mottled clay was found in the darker clays. This was not a kaolin-vein, but probably marked the bleaching action of a slow current of water either from above or from a spring in the limestone.

Above the boulder-clays were sandy beds and lignite. The sand contained tin-ore, sometimes as much as three katis to the cubic yard, and in some sections I have seen small boulders of the tourmaline-corundum-rocks in the lignitic sands, close to the junction with the boulder-clays.

From time to time sections were exposed in the Pusing Bahru Mines for which it was very difficult to find any clear explanation. The late general manager, Mr. W. M. Currie, thought that the clays had been to some extent rearranged by recent river-action, and brought forward as evidence the tin-ore, which he thought to be distinctly water-worn. I cannot see, however, that the ore is more worn than in the supposed glacial beds generally, and think that the sinking of the clays on to the dissolving limestone may be the cause of the difficulties referred to. It would, for instance, be possible in this way to account for fragments of wood and patches of sand being found in clay immediately above the limestone, as, during the sinking movement, some of the younger lignite and sand might become mingled with the older Gondwana clays.

Redhills and Pusing Lama

These two mines are worked on the slopes of a hill composed of clays and soft, laminated, and very much disturbed beds, that are, for the most part, stained a deep-red, whi h has given rise to the name "Redhills." Unfortunately, this deep-red staining makes it difficult to see all that one could wish of the structure.

In the Redhills property is a boulder-clay in which the tourmaline-corundum-rock boulders were so thickly packed together that when the exposures were less clear than they are now, it was thought that the tourmaline-corundum-rock was strictly *in situ*. With these boulders were numerous boulders of argillaceous schistose rocks with corundum. On Pusing Lama a light-colored clay with boulders of tourmaline-schist and quartz was once exposed at the bottom of a tributer's *lombong*.

In both mines veins of secondary ore have been found, the most notable being the Pusing Lama lode, a rich vein of tin-ore at the contact of the clays with a soft granitic intrusion. The unexpected discovery of this lode after flotation saved the company from disaster. It was said to have been completely worked out before 1913, but lately a *lombong* has been opened up by tributers on the junction of the clay and the granitic rock and much ore has been won from it, which is doubtless the remains of the old lode.

Occasionally an exceptionally large boulder is washed out of the clay on Pusing Lama. On the higher ground, where bedded argillaceous rocks are exposed, there are no included boulders, or boulders of tourmaline-corundum-rocks lying on the surface. On the other hand, there are large amounts of ironstone on the surface that formed in the weathering shales, and also aluminous concretions.

Behind Redhills there is a big open-cut in which Chinese miners have cut into the shaley beds, and judging from the character of the work, the tin-ore obtained in this open-cut may have been an original detrital constituent of the shales, or of some thin quartzites associated with them. In some of the shaley beds I saw in 1911 masses of tourmaline-rock, suggesting that the beds might be boulder-clays with lamination induced by earth-movements, but, on the other hand, the tourmaline-rock may possibly be the result of veins breaking up during recent movements, due to the softening of the shales on a hill-slope and the solution of the limestone below, although I do not think this likely.

The tourmaline-corundum-boulders are more abundant in the vicinity of Redhills and Kacha than in any other locality. At the entrance to Redhills there is a road section that shows the boulder-clay.

Rotan Dahan

The Rotan Dahan Mine is a large excavation on rising ground close to the road between Batu Gajah and Pusing. Most of it is now filled with water and tailings, but the road has been diverted to allow of further mining. In this mine there was once visible a great thickness of unstratified clay with boulders. The greatest depth of clay was about 140 feet. The clay carried angular tin-ore from top to bottom and on several occasions native copper has been found with it, sometimes as sharp, minute crystals. The boulders are of pale-colored tourmaline-schist, sometimes with tin-ore, and of schistose tourmaline-corundum-rocks. A fault was once observable in the limestone and slickensides were seen in the clay close to it. No granitic intrusion has been seen as yet in the limestone or clay at Rotan Dahan. Recent sands were exposed above the clay in 1915.

The Serendah Hydraulic Tin Mining Co.

This is the only large mine of particular interest in the portion of Sĕlangor dealt with in this article. The company was floated prior to 1907 and worked with monitors on the slopes of the hilly country to the east of the road leading north from Sĕrĕndah. At first only soil was worked, but the country rock was laid bare and found to be a soft granitic rock with a few veins of quartz carrying a little tin-ore and veins of a rock resembling greisen, also carrying tin-ore. In the biggest working these veins had a general north and south direction.

In another working was a "lode" which appeared to be a repetition on a large scale of the veins of greisen-like rock. The direction was W.N.W.-E.S.E. It extended for about 150 feet and had a breadth of 20-30 feet. The rock was composed of quartz, white mica, tourmaline in small masses of needles that gave the rock a spotted appearance, kaolin, and small crystals of cassiterite.

Later on, the operations of this company exposed the junction of granite and schists.

Siputeh Tin Mines, Ltd.

The Siputeh Mine, now worked on tribute, showed in its earlier days some excellent examples of "cups" in limestone with a lining of stanniferous clay and a filling of lignite and sand.

The boulders in the clay are mostly of tourmalinized sandstone with quartz-veins and yellow crystals of cassiterite. In one face a hard flat boulder of granite was found and two or three boulders of a softer granitic rock with crystals of cassiterite.

At the time of writing (1915-1916) the only important work going on is in the tributer's big mine near the railway. Here an excavation has been carried down to about 120 feet with limestone on one side and weathered and contorted quartzite and shale on the other. The relation of these latter to the boulders is discussed elsewhere. In 1914 a quartz-vein was seen in the limestone in this vein.

When the Siputeh Mine was first opened great trouble was caused by the limestone cups. Their presence had not been suspected and the first excavation made ended abruptly against a solid vertical wall of crystalline limestone that made progress impossible.

Tambun

In the vicinity of Tambun village, north of Ampang, deep clays with angular tin-ore occur, but the clays differ from those elsewhere in containing very few boulders. In 1913 they were well exposed in the New Tambun Mine and a few boulders were found there. One was of tourmaline-granite; another was gneissose.

In the New Tambun Mine the bed-rock was found in one place to be dolomite, and soft, weathered bedded-rocks were also exposed. Their relation to the clay was not clear but they may have been faulted down against the clays, just as the clays were faulted down against the limestone. The manager at that time informed me that bores had been put down to 80 feet in these rocks, and that they were generally sandy and yielded a little tin-ore throughout. They were traversed by numerous thin kaolin-veins.

In Towkay Leong Fee's Mine at Tambun both clays and soft phyllites, etc., are exposed, and both have been invaded by large granitic veins. It is probable that the large amount of tin-ore won from the clays has been in part introduced as an impregnation from these veins. Small veins of a similar nature have been found traversing the limestone bed-rock. The clays vary in color and immediately above the limestone they sometimes contain pyrolusite, but not in sufficient quantity to be of value as manganese-ore.

I have not seen any boulders from these clays excepting a few lumps of cassiterite, which, however, might possibly have been secondary tin-ore derived from the granitic veins.

In the Tambun Mine also the relation of the phyllites, etc., to the clays is not clear. They are very highly inclined.

The clays sometimes show traces of lamination.

I have been informed recently that the bedded argillaceous rocks sometimes contain good tin-values. Amongst these bedded-rocks I have found moderately hard sandy tourmaline-schist.

Tapah

Tapah is the centre of a small mine-field that is distinguished from other mine-fields in South Perak by producing an appreciable amount of gold as well as tin. It has also been a source of wolfram for a numberof years.

The mineralization of this area results from the existence of an isolated out-crop of granite that extends from Jong Landor estate in the north nearly to Bidor in the south. In the north there are out-crops of hard non-porphyritic granite; towards the south the out-crops are of soft granitic rocks rich in kaolin. The junction between the granite and the sedimentary rocks on the east almost coincides with the road. On the west it is hidden by vegetation and alluvium.

On going southwards from Tapah one comes first to Bukit Mas, on the left of the road. This locality is well known as having been the site of mining-operations on a gold-lode prior to 1904. In 1911 interest was revived in the place and some prospecting done and it was possible to get definite information about the occurrence of the gold. In a new adit it occurred in quartz-stringers in weathered schists, and a Chinese who had worked in the old mine stated that all the gold had occurred in this way. Prospecting in the soil near the old workings showed gold to be present, but not in large quantities.

Reasons have been heard of for the failure of the old mine. They all concerned difficulties in the work, particularly driving under the floor of the valley where the mine is situated. Judging from the information received, however, and the position of the old workings, I am inclined to think the real reason why Bukit Mas failed as a gold mine was the same as that which ends many a mine—namely, that there was not enough gold to pay.

Gold is still won by Chinese working for tin and is separated. A concentrate from Batang Padang in the Perak museum collection, and which probably comes from near Tapah, contains gold, cassiterite, and native copper in sharp crystals. The copper crystals are slightly larger than those found at Rotan Dahan in Kinta. Near the site of the old gold mine there are extensive *lampans*, mostly deserted. The country rock is weathered phyllite striking about north and south and dipping steeply westwards. Numerous small quartz-veins and a kaolin-vein traverse the phyllites and small boulders of granite are found on the surface.

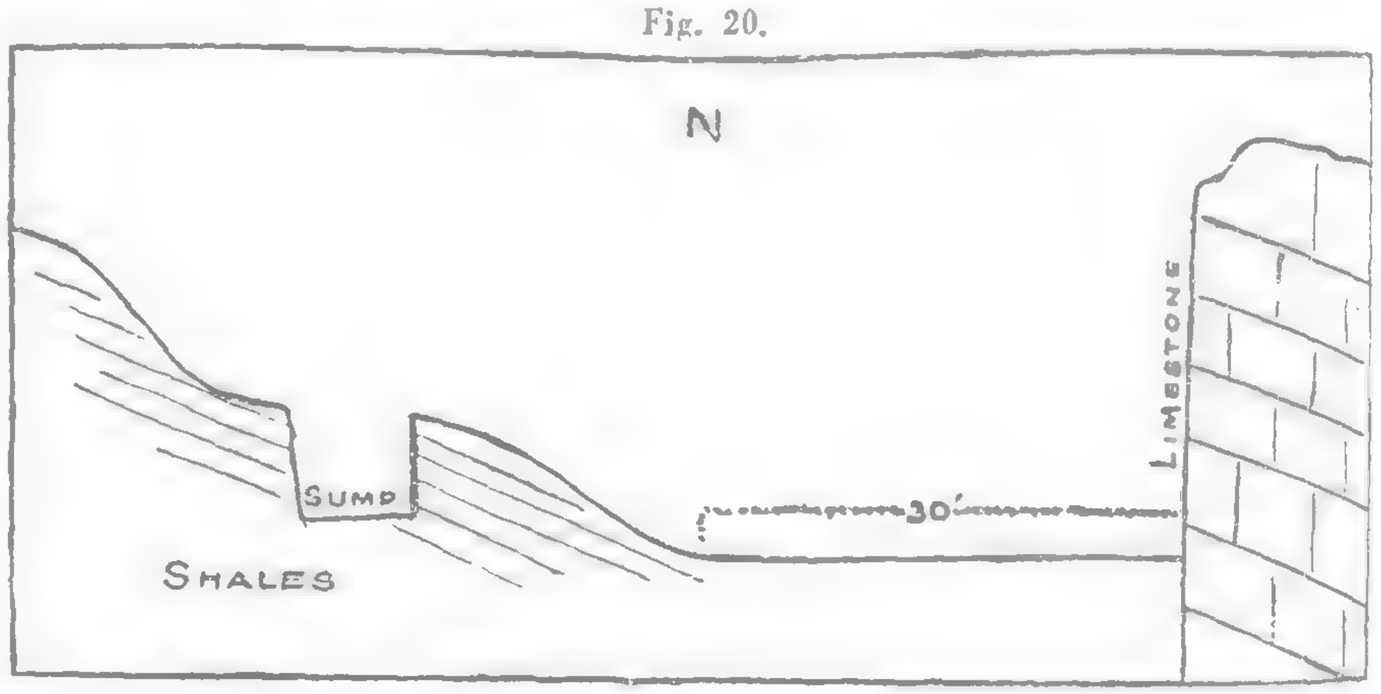
On the opposite side of the road from Bukit Mas, is a steep hill (668 feet) of tourmaline-granite, named Bukit Rĕmbian on the survey department maps. This tourmaline-granite is the source of the wolfram that has been exported from Tapah. It occurs with tin-ore in small quartz-veins. The tin-ore, and perhaps the wolfram too, may occur as a dissemination. In the soil the ore is fairly evenly distributed, but that may be entirely due to soil-creep.

From Bukit Rĕmbian one gets a very good view of the quartzite hills in the southern part of the Batang Padang district, and of Changkat Jong in Lower Perak.

South of Bukit Rĕmbian there are the remains of extensive mining-operations in the Jangka Valley, in granitic rocks on the west of the road, in phyllites and quartzite on the east. The granitic rocks are veined with kaolin and quartz, and there are quartz-veins in the phyllite. Tin-mining operations are now going on at the southern end of the granitic exposures near Bidor, and near Bruseh gold also has been worked.

In 1915 the output of gold from the Batang Padang district (mostly, if not all, from the vicinity of Tapah and Bidor) was 1,285 oz. valued at £4,980 as against 935 oz. in 1914.

Fig. 20.



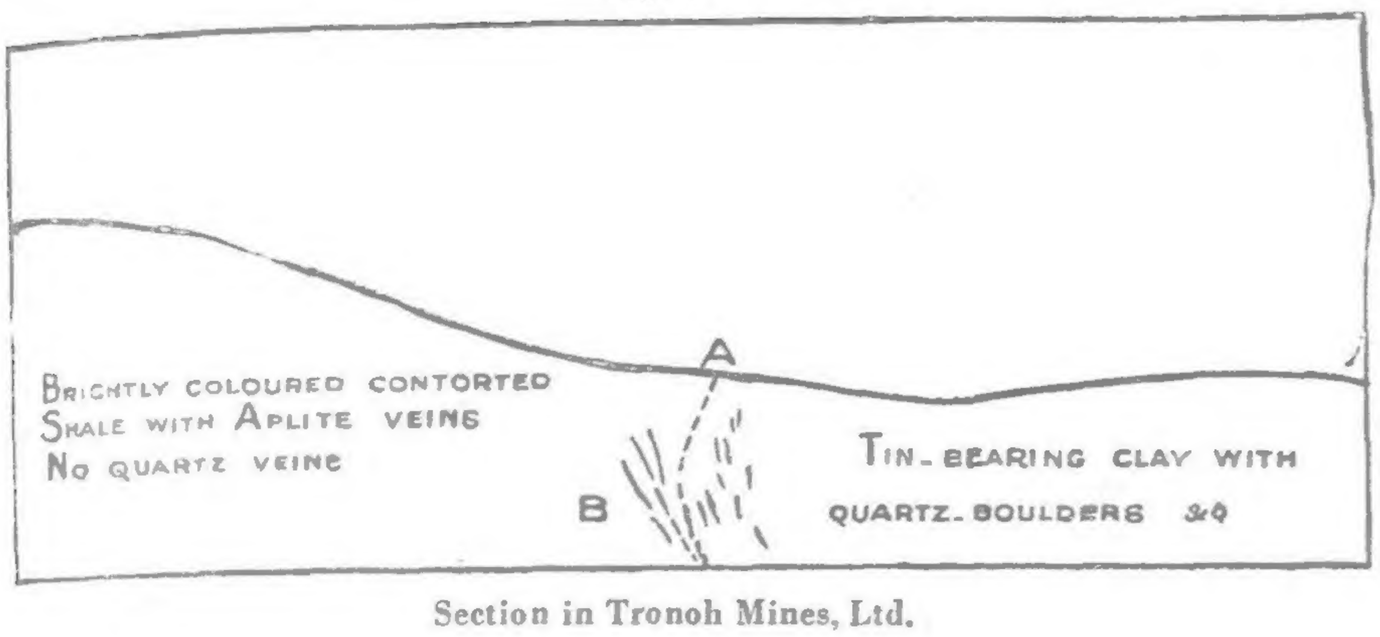
Section in South Tronoh

Tanjong Toalang

The little tin-field at Tanjong Toalang, once a big producer of ore, attracts attention on account of its isolation and the difficulty, at first sight, of finding any reason for its existence. The country consists of rolling hills formed of quartzite, shales, and tourmaline schists. The latter suggest the presence of tin-ore, but cannot be the source of the richer deposits that have been worked. Near the village, however, there is abundant evidence of granitic intrusions rich in kaolin having invaded the sedimentary rocks, and the most prosperous mines have been found in the vicinity of these intrusions. I have been told that in one mine a small vein of tin-ore was found, but the details of its occurrence could not be ascertained.

These granitic intrusions are not unlike the kaolin-veins that cut the clays at Gopeng and Tambun, and it is probable that they

Fig. 21.



Section in Tronoh Mines, Ltd.

are connected in depth, like the granitic intrusions at Tronoh, with the Kledang granite-mass. The occurrence of these intrusions and of old tin-workings at Bias Tujoh, near Kampar, may mean that the Kledang and Bujang Mĕlaka masses are connected at no great depth below the present surface.

An interesting point about the Tanjong Toalang tin-field is the occurrence of boulders of the tourmaline-corundum-rocks. I have seen these in one place only, heaped up beside a small flooded mine close to the police-station. I have not been able to see how they occur in the mine, but their presence shows that the Gondwana clays occur here as well as the quartzites and shales.

Tronoh

The village of Tronoh is the centre of a prosperous mine-field, which contains the well-known mine belonging to the Tronoh Mines Co., Ltd., also Towkay Chung Thye Phin's Mine and the Tronoh South Mine, which are the only mines that need be described in detail here.

Between Tronoh South on the one hand and Towkay Chung Thye Phin's Mine on the other, there is a gap. It has yet to be proved whether the two mines are connected by a continuation of what is generally referred to as the "Tronoh lead." The term was borrowed from Australia where "deep-leads" are known and was first applied, I believe, by an Australian miner to the Tronoh deposits, which are conspicuously different from the Australian deep-leads, the chief point about the latter being that they are old alluvial deposits buried under flows of lava. I have not seen evidence of such a state of affairs anywhere in the Federated Malay States. What is known as the "Tronoh lead" is a huge trough in the limestone bounded on the west by a fault-face of shales and quartzites with granitic intrusions.

The dominant factor in the structure of this part of the mine-field is a reversed-fault which is clearly exposed in all three mines. It trends about N. N. W..-S. S. E. and hades at about 45° to the east. On the west are the quartzites and shales and granitic intrusions, in the vicinity of which a hard hornstone is formed. There are also numerous small fissures bounded by tourmalinized shales. On the east of the fault is limestone, which forms a trough close to the fault and rises nearer the surface on the east.

The following evidence of dips has been collected. In the quartzites and shales the bedding is much disturbed in the north part of the Tronoh Ltd. Mine. In the main part of the mine the dip is gentle to the W. N. W. near the edge of the excavation, but nearer the centre it is to the E. S. E. and S. E. In Towkay Chung Thye Phin's Mine the dip as seen on an incline cutting across the strike is 45° to the E. S. E. In Tronoh South good observations of the dip were obtained in two sections close the limestone (*see* Fig 20). It is about 20° to the E. S. E. Other easterly dips have been observed in Tronoh South.

In the limestone, which is now exposed in the bottom of all three mines, a dip of about 60° to the S. E. can be seen in the Tronoh Ltd., main excavation and in Tronoh South the dip is about 20° to the E.S.E. in some places to the east. In Chung Thye Phin's Mine the dip of the limestone has not been seen clearly.

In the Tronoh Ltd. Mine recent work has largely destroyed the smooth fault-face on the west of the excavation, which, hading to the east, showed that the fault is reversed.

In the quartzite and shale small subsidiary faults are present, which not infrequently break the course of aplite-veins traversing these rocks. The big faces of these rocks in the three mines afford very good sections. In 1914 a section was seen showing as clearly as a text-book diagram shales traversed by abundant minute kaolin-veins and by fissure-veins with quartz as a vein-mineral and tourmalinized shale one ither side.

Wolfram was found in 1915 in a quartz-vein. I have been informed that there is only a little tin in the shales and quartzite.

Tourmaline, generally brown, is the commonest metamorphic mineral in these rocks, but other minerals have been found. The heavy minerals separated from a specimen of altered sandstone (not seen *in situ*) in 1905 were tourmaline, cassiterite, corundum, and perhaps topaz. Minute octahedra resembling spinel also have been found in sections of these rocks. Epidote and fluorite occur.

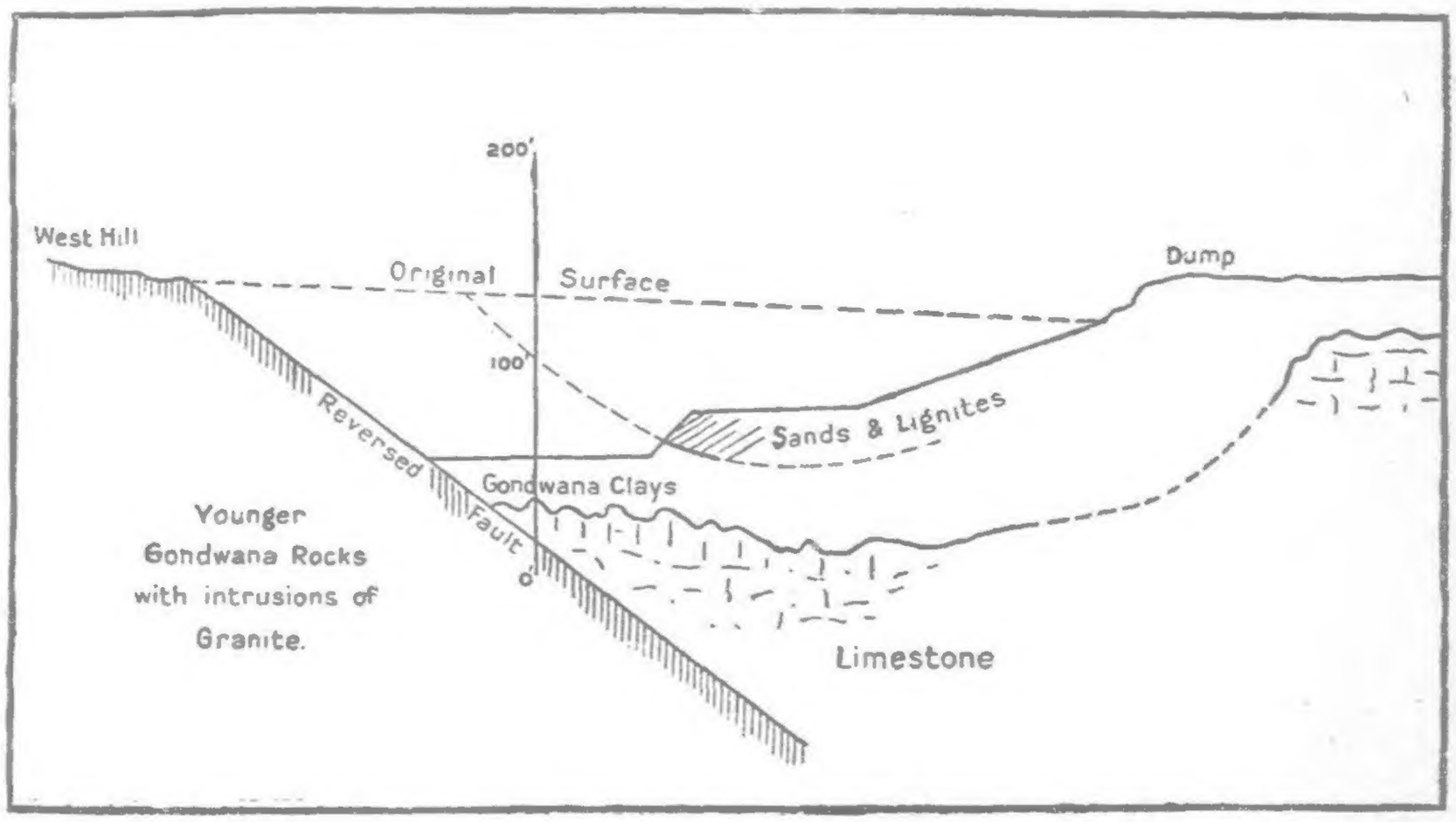
On the east side of the fault a mass of recent sand and partially carbonized vegetation overlies the limestone, and perhaps the tin-bearing clay also.

Fig. 21 is a typical section showing the relation of the pay-dirt, or *karang* in the Tronoh Ltd. Mine to the shales. On the left (W) are contorted shales with aplite intrusions and, I am told, a little tin-ore, probably derived from them. At B are a few small pieces of quartz. At A is a line of division between the shales and the pay-dirt. It is not very distinct but is nevertheless a line of division. The pay-dirt on the right of it shows some sign of streakiness and contains bculders. The amount of tin in the *karang* is greatly in excess of that in the shales.

In Towkay Chung Thye Phin's Mine, a noticeable feature ist he narrow gut between the shales on one side and the limestone on the

(Continued on page 601).

Fig. 22.



Section of the Tronoh Opencast Mine, looking NNW.

Reduced fram a Section drawn to Scale. The vertical line gives heights in feet. The original surface is shown by a dotted line. The west wall of the Open-cast Mine coincides with the reversed fault-plane. The presence of this fault was probably the cause of the formation of the "Cup" in the limestone, surface water finding it an easy channel downwards. The curved dotted line indicates the probable inclination of the Gondwana clays before mining commenced.

The Morse Fuel Oil System

Installed on the T.K.K. Steamships

IN the two short years since its introduction into the marine and industrial service, the Morse system has attracted wide and favorable attention because of the many new features until to-day Morse-equipped ships may be found throughout the seven seas. As a result of this rapid progress it has placed the burner with the leading types of similar apparatus and has caused ship owners and operators throughout the world to give serious consideration to the Morse burner when contemplating an oil-burning installation.

Having installed all types of oil burning equipment for the last twenty-five years, Morse engineers were able to observe each burner in actual operation and to determine what the outstanding characteristics of each type of equipment were. By combining these features and adding thereto some distinctive designs of their own, Morse engineers created the Morse fuel oil system.

Briefly, the Morse system for marine service may be divided into two kinds of equipment, natural draft and the combination natural-forced draft. It is based on the principle of forcing fuel oil at proper pressures through a burner or atomizer which can be regulated without changing the pump pressure. Following this controlled and fine atomization the supply of air for combustion, under complete regulation, enters the fire box at sufficient velocity (due to the Venturi design of Morse register) and at right angles to the oil spray so that a perfect mixture takes place at the burner tip, both the oil and the air entering the combustion chamber in a whirling motion so arranged that air is admitted to the combustion space. The advantages and benefits are obvious.

Illustrations above clearly show the basic principles of the Morse burner ; how a wide angle of uniformly and finely atomized oil is secured ; how complete intermixture of oil and air are brought about in the *front* end of the furnace and the convenience of the regulating levers.

Following are some of the important features of the Morse Fuel Oil System :

1. Full utilization of boiler heating surface because combustion takes place in the front of the furnace.

2. No danger to rear staybolts or brickwork, due to flame impingement. This feature alone has been the means of considerable saving to owners of Morse-Equipped vessels.

3. When it is advisable to have slightly reduced conditions, or if it is necessary to shut off the air supply entirely, it is much more easily done with the Morse Type of control.

4. Flexibility of control and complete atomization coupled with the unusual regulation and application of air supplied by the Air Register, result in smokeless flame and the highest attainable percentage of CO2.

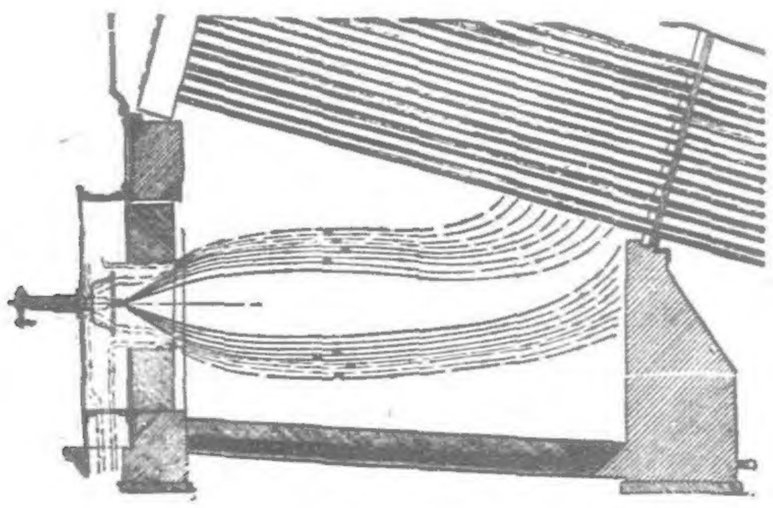
5. Fuel Oil pressure at orifice constant at all times.

6. Oil completely atomized at all stages of flame intensity, whether high or low.

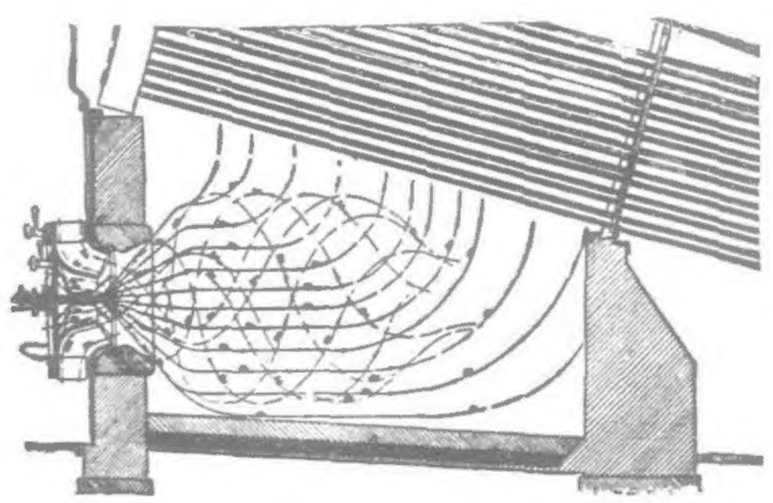
Not only has the Morse Fuel Oil System received a warm reception in American shipping circles, but foreign ship owners as well, have expressed their hearty approval. This is substantiated by the fact that the Toyo Kisen Kaisha have equipped six of their vessels with Morse Burners. Following are given some interesting figures taken from the log of the s.s. *Biyo Maru*, one of the six Toyo Kisen Kaisha vessels to be fitted, while on her first trip.

Type : Turbo Electric.

Steam pressure	220-lbs.
Number of boilers	3
Actual No. of boilers used	2
Actual No. of burners used	6
Average speed in knots	10.51
Average fuel oil consumption per day-tons	17.45
Fuel oil consumed per kw	1.41
Fuel oil consumer per SHP	1.05
SHP	0.86-lbs.
FUEL OIL CONSUMED PER IHP per hour, including auxiliary machinery	.90-lb.



The Ordinary Way



The Morse Way

These figures were taken from her first trip and there has been a further reduction in fuel consumption in active operation.

This success has not been confined merely to vessels of the Toyo Kisen Kaisha.

A recent installation is worthy of mention here. The s.s. *Rosalind* of the Red Cross line is a combination freight and passenger ship running between New York, Halifax and St. John. About three years ago it was decided to remove the coal-burning furnace fronts and install one of the leading oil-burning systems in the field. After a year's operation the owners were not entirely satisfied with the performance of the vessel and asked another manufacturer of oil-burning apparatus what saving they would guarantee were their burners installed.

Accordingly, this other burner was given a trial with the understanding that a certain saving had to be made. When the trial period was over a saving of less than $\frac{1}{2}$ of 1 per cent. had been effected—*far below the guarantee*. The Morse company was then asked what they could do in the way of decreasing fuel consumption. Before committing themselves a careful survey was made to ascertain exactly what conditions had to be met and after a conference of Morse engineers, a proposal was made whereby the Morse company guaranteed to save 7 per cent. of the fuel consumption over a trial period of eight voyages. Upon the expiration of the eight voyages an average saving of approximately 11 per cent. had been obtained—considerably over the original guarantee.

Additional figures on other Morse oil-burning conversions can be obtained by writing to the American Trading Company, of Tokyo and Osaka, Japan, where the Morse company has an engineer who can give prompt and efficient service.

The Morse fuel oil system is manufactured by the Morse Dry Dock & Repair Co. of Brooklyn, New York, which company has been continuously engaged in the ship repair business for the past forty years. They maintain a permanent combustion engineering staff, who will be glad to contribute their years of experience gained in fuel oil burning, to assist ship owners and operators in solving their combustion problems.

Tin Smelters in Malaya

Straits Trading Company, Ltd.

THE largest and best-known of the active tin-smelting companies of the world—which, with the exception of the scattered plants in the island of Banca, are to-day all under the British flag—is that of the Straits Trading Company, an undertaking founded in 1887. Its origin, which it shares with other tin smelters of to-day, was due to the development of a successful ore-dealing agency carried on by Messrs. James Sword and Hermann Mühlinghaus in Sungei Ujong and Selangor, in the southern part of the Federated Malay States. In those earlier days of the tin industry of Malaya the smelting of the ore was carried on by Chinese kongsis according to the primitive methods employed by the Chinese. However, the success of the ore-dealing business encouraged the partners to attempt to advance their business a stage further by undertaking smelting themselves, being assured of an adequate ore supply, and accordingly they erected a small reverberatory furnace at Teluk Anson, in the state of Perak. The first essay, however, was not successful. The promoters, however, were not discouraged, and not long afterwards a more serious attempt to operate on European lines was attempted, and smelting works were erected on the island of Pulau Brani, in the harbor of Singapore, which, progressively remodelled, re-equipped, and enlarged, constitute to-day the main site of the company's activity. In 1902 a second smelting works was started at Butterworth, in province Wellesley, which also has steadily developed, and was completely modernized, as well as being greatly enlarged, after the war. Mr. Mühlinghaus was the leading spirit in the earlier developments, as well as being very largely interested in the company for many years, finally retiring in 1902. Meanwhile the capital of the company was steadily increased from the original $150,000 up to a present capital of $15,000,000, of which $9,000,000 is issued capital. The original ore-buying business from which the company originated has remained an integral part of the undertaking. The company maintains its agencies in all mining centres of Malaya, and in process of time has extended its ore-buying business further afield. Undoubtedly, however, the main factor of success, apart, of course, from technical efficiency and good management, has been its geographical association with the largest tin-producing field in the world. With the exception of the mines worked to-day by the Pahang Consolidated, practically the whole of the Malayan output is alluvial, giving a high-grade and clean concentrate, which has done much to secure for Straits tin its leading position in the world's markets. In fact, the most serious danger which has threatened the company was the attempt made by American interests, through the medium of the International Tin Co., to enter the Malayan field as an ore buyer on a big scale and ship the concentrates to the smelter which they were erecting at Bayonne about 1903. The American design aimed at differentiating between pig tin and tin ore in respect of import duties, thus creating protection for a tin-smelting industry in the U.S.A. This threat was, however, decisively countered by the F.M.S. government imposing a prohibitive export duty on ores exported for smelting outside the empire.

As the business grew the company became a buyer in Australia and later in South Africa, and though the Australia trade is no longer a business proposition, owing largely to the decline in the output of tin ore there and high tin freights from the Straits, the company has, since the war, retained much of the South African business. Just after the outbreak of war the company made a determined effort to penetrate into the remote Yunnan field, sending a representative up to Kochiu. Progress, however, owing to vested interests, was very slow, and when their representative died on the field, the directors decided, in view of the growing disintegration of any centralized government in China, that any scheme of the kind was a waste of time under present conditions, and for some years past they have retired from the field. In view of the great demand for tin which developed during the war, they also sent a representative to Bolivia, who purchased a certain amount of Bolivian concentrates, but here again free ores of good quality were scarce and freight conditions adverse, so that after the death of their agent this attempt was also not proceeded with.

Meanwhile, the more natural source for further ore—the Dutch Islands—were not neglected. For many years a portion of the Billiton output had gone regularly to Pulau Brani, and the results were so satisfactory to the Billiton company that, later, arrangements were made for the whole of the output to be treated by the Straits Trading Company. This supply increased so largely in recent years—rising to just under 12,000 tons of metal in 1922-1923—that it became quite an important source of supply. Later on the company were able to offer the Dutch government terms which induced them to ship a portion of the Banka output also for reduction in the Straits, and this arrangement still continues. Finally, the Straits Trading Company receives the small amount of concentrate which is produced annually in Alaska. It will thus be apparent how it is that the Straits Trading Company is in a position to produce more tin than is actually mined in the Federated Malay States, notwithstanding the fact that a portion of this output is handled by the Eastern Smelting Company, as well as nearly 6,000 tons by the Chinese smelters still in the F.M.S.

The actual capacity of the company's combined works rises to-day to the high figure of 60,000 tons per annum, but, like all large smelters, it is a great practical convenience to have a considerable excess over ordinary requirements to allow for emergencies as well as for repairs and renewals of plant. As the company strictly confines itself to its business of ore buying and smelting, the sales correspond closely with production, and these in recent years figure as follows :—

Year.	Tons.	Year.	Tons.
1907	40,205	1916	43,507
1908	47,768	1917	37,887
1909	40,297	1918	36,241
1910	35,346	1919	37,315
1911	38,252	1920	28,294
1912	36,489	1921	27,759
1913	43,017	1922	39,690
1914	41,718	1923	45,514
1915	47,249		

Some idea of the magnitude of the operations may be gathered from the accompanying block, which shows a part of the refinery at Pulau Brani. Altogether, in the course of its history, the company has sold 435,000 tons of metal, of a total value in round figures of £100,000,000.

The company's works have always been regarded as among the most efficient in the world. To-day the smelting is done in large regenerative reverberatory furnaces with gas firing, and quite lately the experiment has been undertaken of fitting a Cotterell precipitation plant to deal with the furnace gases, which always carry a certain amount of tin, either volatilised or in the form of fine particles.

The Straits Trading Company is registered in Singapore, and constitutes one of the most important undertakings in the colony. The conveniences which it offers to miners as an ore buyer have contributed substantially to the development of the tin industry in the neighboring states, and the Malay government has not been slow to utilize its services and that of the sister smelter, the Eastern Smelting Company, in the very difficult and delicate operations which it undertook on several occasions in recent years when carrying tin during periods when the market was entirely disorganized. In fact, without these great ore-buying and smelting undertakings it is difficult to see how the great tin-mining industry of Malaya could have reached its present achievement.

The Eastern Smelting Company

There is no branch of the mineral industry which more widely reflects British influence than tin. The widely-separated sources of production—the East Indies and Bolivia are almost antipodal—have an analogy with the world-wide extension of the British empire, while historically Cornish dressing and reduction practice have spread the world over, and in this most staple of metals still remain generally standard practice.

The Straits Settlements have long been the great centre of tin production in the world. Last year, out of a total world's supply of approximately 126,000 tons, Straits shipments amounted to no less than 66,297 tons. While a small portion of this was from the small primitive blast furnaces of the Chinese miners, more than 90 per cent., probably was from the two great European-controlled enterprises, the Eastern Smelting Co., and the Straits Trading Co.

The Eastern Smelting Co., unlike its sister enterprise, is of comparatively recent origin. It was started as recently as 1911, largely through the initiative of Mr. H. Jessen, who succeeded in interesting the firm of Vivian Younger & Bond, with their wide experience in tin smelting, in the possibilities offered by the East, while the support of Sir Ernest Birch assured intimate knowledge of tin-mining conditions in the Malayan Peninsula.

Steadily achieving success, the new company made rapid strides, and to-day, with one of the chief smelting equipments in the world, it is with its associations one of the four great factors in the tin-producing capacity of the world.

In the Malay Peninsula the Chinese smelt tin ore by a primitive method, in small clay shaft furnaces (known as "relau"), in which charcoal is used as the reducing agent, whereas European smelting companies use large reverberatory furnaces, coal being the reducing agent.

Eastern Smelting Co.'s Practice

The following details of practice are kindly supplied by the company. Smelting in reverberatory furnaces is carried out as follows. The tin ore is mixed with coal (anthracite), a little lime is sometimes added, and the whole is then fed into the furnace through the charging doors. The charge is levelled by means of a long-handled rake (rabble) introduced through the charging or working doors; the doors are then closed tightly, and a regular fire is applied for a period ranging from five to twelve hours. At the end of this period the fused mass is thoroughly stirred, this being done through the working door, the position of which, under the chimney, prevents the in-rush of air from coming in contact with and oxidising the tin. After this a strong heat is applied for a period of one to two hours, and the charge is again stirred.

The reduction of the tin, as well as its separation from the slag, should now be complete. The tin is drawn off through the tap-hole into a float or kettle, from which it is ladled into moulds, and the slag is run off into slag beds.

The products of this process are crude or furnace tin and slag. The slag, which is rich in tin, is again smelted, giving a poor tin, rich in iron, and a final slag, the tin content of which is negligible.

Refining.—The crude tin drawn off from the furnace is usually impure, and contains different metals—*e.g.*, iron, copper, lead, antimony, arsenic, and bismuth. As these impurities detract from the market value of the tin, it is necessary to remove them by a process of refining, which consists of liquation and "boiling" of the tin. The ingots of crude tin are melted down in a furnace at a low temperature, and the molten tin is allowed to run into a large iron pot or kettle, the less easily fusible metals remaining behind on the bed of the furnace. The tin which collects in the kettle is kept molten during the "boiling" by means of a fire underneath. The "boiling" consists of introducing into the bath of heated liquid metal a log of green wood. The wood, at the high temperature, undergoes dry distillation, and the gases and vapours given off set up a bubbling action in the bath of metal. By this means every portion of the mass is brought into contact with the air, the foreign metals and a portion of the tin being oxidized. The oxides collect together in a foamy mass the so-called "boilscum" on the surface of the metal. The duration of boiling depends on the state of purity to which it is desired to bring the tin; if a high degree of purity be required, the boiling must be continued for many hours. It is continued until the surface of the molten metal, after removal of the scum, is bright and shining, after which the molten mass is allowed to stand for some time, in order that the heavy impurities in the tin, especially iron and copper, may settle to the bottom. After this the scum is skimmed off, and the refined metal is ladled into moulds. It is then ready for the market as pure tin, and is shipped to all parts of the world.—*Mining Journal.*

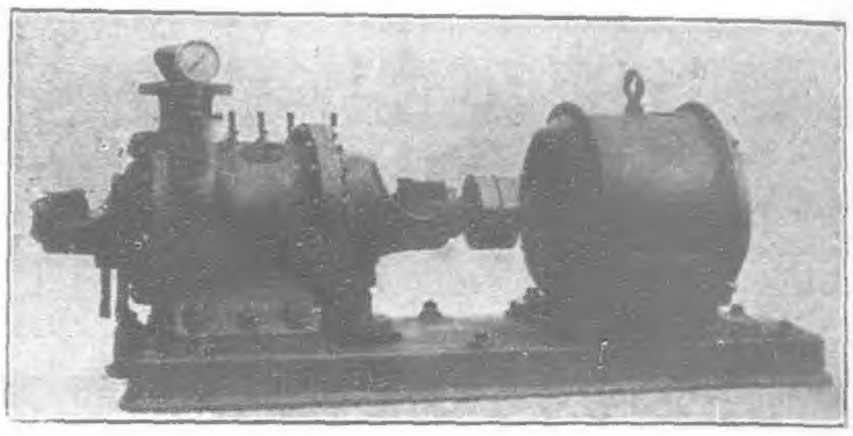
SULZER BROTHERS

SHANGHAI ENGINEERING OFFICE
No. 4 AVE. EDWARD VII

蘇爾壽工程事務所 上海愛多亞路四號

SULZER HIGHLIFT CENTRIFUGAL PUMP.

本公司常備目錄供給各界 垂詢工程事務亦易誠酬答

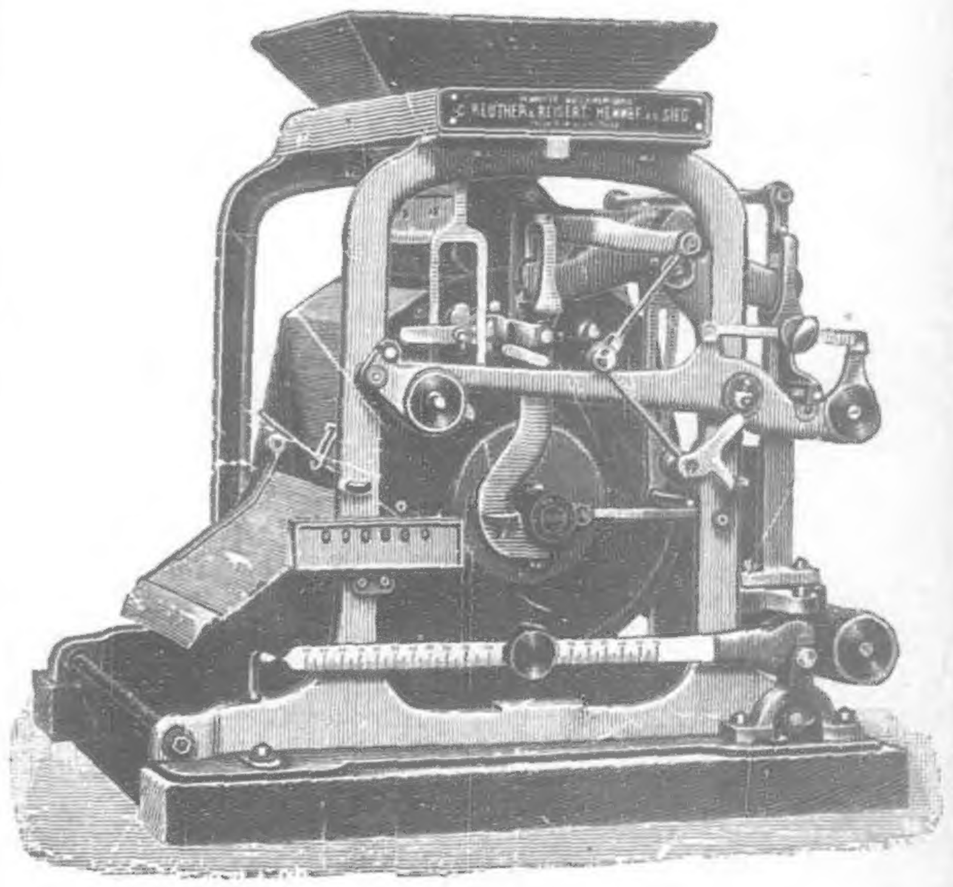


Uniflow Steam Engines, Upright Water-tube Boilers, HIGH AND LOWLIFT CENTRIFUGAL PUMPS, Fans and Ventilators for all purposes, Fire Engines, Stationary and Marine Diesel Engines, Airless Injection Diesel Engines, Ice and Refrigerating Plants, Maag Gears and Maag Gear Planing Machines.

WINTERTHUR. SWITZERLAND.

For Use in Mills, Breweries, Warehouses, Elevators, Sugar Factories, etc.

Cable Address: "Chronos Hennefsieg"



Use A B C Code 5th Edition

Patent Automatic Scales

"CHRONOS"

For Weighing Wheat, Rye, Barley, Rice, Flour, Oats, Maize, Oil-Seeds, Oils, Beet Sugar, Coals, etc. *They work and register quite automatically.*

They save time, labor and money!

Over 40,000 "Chronos" scales are working all over the world to the utmost satisfacti

Hennef Engineering Works C. Reuther & Reisert, Lt

Hennef on Sieg (Germany)

Oldest and largest Works for automatic self-registering weighers.